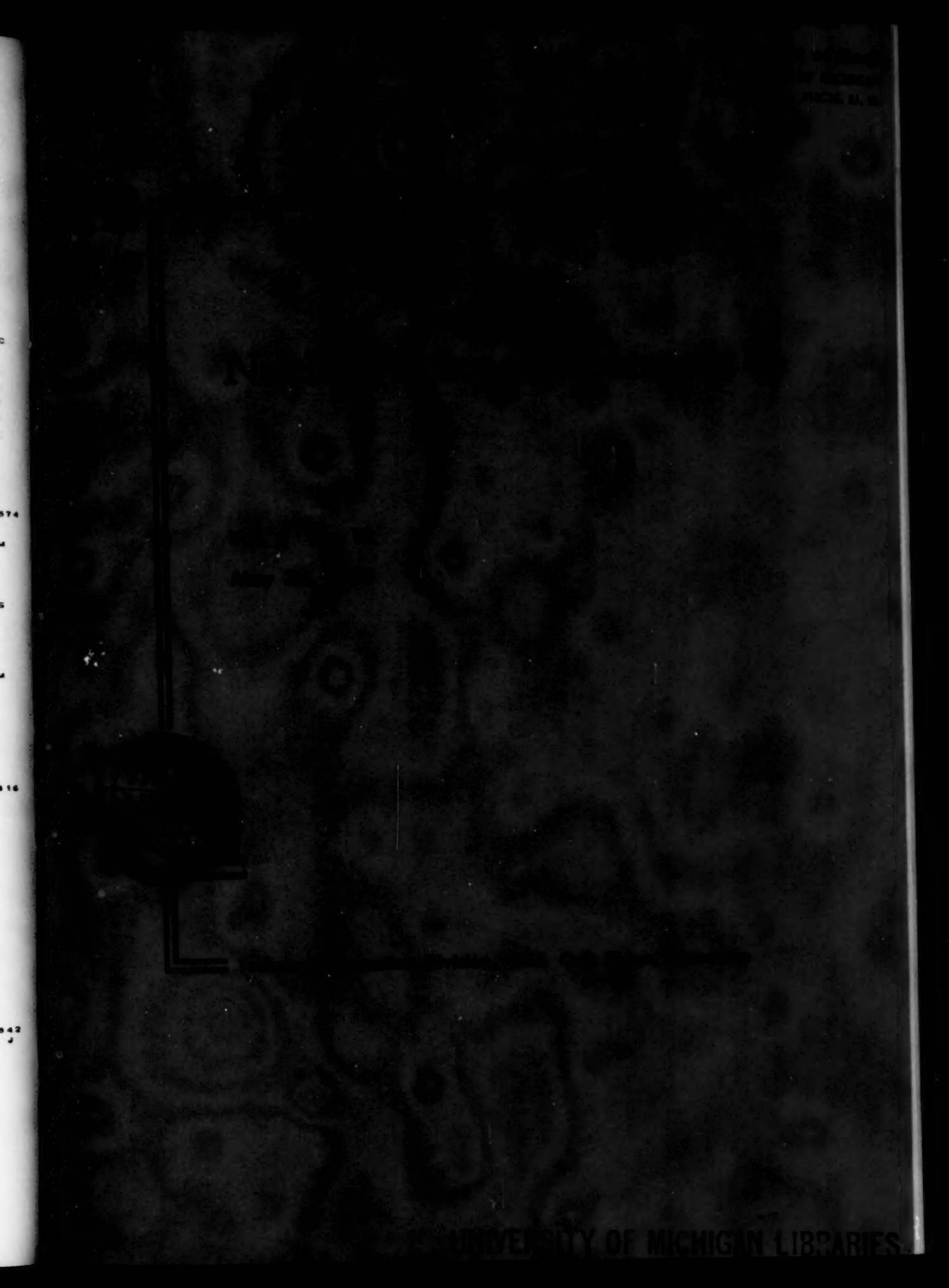

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| HW-16079 | The Behavior of Electrodes in a High Intensity Radiation Field. E. M. Kinderman and W. N. Carson, Jr. | 3011 |
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| ORNL-201 | A Study of the Slowing Down Distribution of $Sb^{124}$-Be Photo Neutrons in Graphite, and of the Use of Indium Foils. L. D. Roberts, J. E. Hill, and G. McCammon. | 3170 |
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| UR-105 | Physicochemical Studies of Beryllium Complexes. III. A Quantitative Investigation of the Beryllium Citrate Complex in Basic Media. R. Danley, I. Feldman, and W. F. Neuman. | 2997 |

GENERAL

2844 Atomic Energy: The Technical Facts. New Republic (special section, Part 2) 1950, p. 3-8. Apr. 3.

This is a review of facts and conjectures, published elsewhere, regarding uranium-plutonium bombs and H-bombs, world resources of fissionable material, and the economics of peace-time and military applications of atomic energy.

2845 Industrial Applications of Atomic Energy; Present Limiting Factors and Some Prospects. M. L. Oliphant. Chem. Age (London) 62, 369-72(1950) Mar. 11.

The author explains, in simple terms, the fission process in $U^{235}$, and describes a fast neutron reactor composed of this isotope. He then discusses the construction of slow neutron reactors composed of uranium with a high $U^{238}$ content, and the possibility of constructing breeder piles which use thorium, as well as uranium, as a fuel. It is the author's belief that power obtained from nuclear sources will eventually be much cheaper than any other type of power. The concluding section of the article is devoted to a discussion of the possibility of using a hydrogen-helium process as a power source.

2846 Nuclear Physics and the Engineer. J. M. A. Lenihan. Steam Engr. 19, 219-22(1950) Mar.

The general features of nuclear reactors are discussed in nontechnical terms. The author describes the present concept of nuclear structure, and the mechanism of natural and artificial nuclear disintegration. He then considers the problems involved in the construction of a uranium pile and, in particular, of a pile consisting of a mixture of $U^{235}$ and $U^{238}$ with a graphite moderator and cadmium control rods. These problems are discussed from an elementary point of view, and no engineering details are mentioned.

2847 The Problem of Atomic Energy. Walter Gerlach. Munich, Bavarian Academy of Science, 1948. 16p. (in German).

A review of the history and theory of atomic energy.

BIOLOGY AND MEDICINE

2848 The Effect of Adrenocorticotrophic Hormone upon Uropepsin Excretion. Howard M. Spiro, Robert W. Reifenstein, and Seymour J. Gray. AECU-737, nd. 21p.

Studies have been undertaken to determine the effect of adrenocorticotrophic hormone (ACTH), and anterior pituitary hormone, to determine its effect on gastric function. The production of uropepsin, a proteolytic enzyme found is the urine of normal individuals, and gastric pepsin are used as indexes of gastric mucosa activity.

It was determined that: ACTH injected into experimental subjects produces an immediate and marked increase in the 24-hr excretion of uropepsin. A functioning gastric gland is necessary for this response. The effect of ACTH upon uropepsin excretion is abolished by total gastric resection and is absent in patients with pernicious anemia and gastric atrophy. The effect of ACTH upon uropepsin excretion is mediated through the adrenal gland. Patients with adrenal insufficiency excrete no uropepsin in the urine and do not respond to ACTH stimulation. The administration of compound E (17-hydroxyl-11-dehydrocorticosterone), however, results in an increase in uropepsin excretion. Evidence is

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presented indicating that ACTH stimulates gastric gland activity by way of the adrenal gland to produce an increase in gastric juice pepsin as well as urinary uropepsin. These studies indicate that the gastric gland responds to adrenal hormones. 11 references.

2849 Fluorine and Other Trace Elements in Nutrition. F. J. McClure. J. Am. Med. Assoc. 139, 711-16 (1949) Mar. 12.

This is a discussion of the use of fluorine in dental caries and the possible mechanism of its action; nutritional considerations of Mn, Co, Zn, and Bo are also presented. Studies on radiozinc show increased excretion in 41 human cases of uremia and tuberculosis but no correlation in cases of albuminuria; some evidence on radiocobalt given to rats and cows indicated there is a primary depository in the liver; studies on chickens, rats, dogs, and humans with radiomanganese show that the pancreas and the liver play important roles in the metabolism of this substance.

2850 Glossary of Nuclear Energy Terms. Section VI. Biophysics and Radiobiology (prelim. ed.). National Research Council Conference on Glossary of Terms in Nuclear Science and Technology. New York, American Society of Mechanical Engineers, Jan. 1950. 47p.

The inclusion of terms has been limited to (1) those peculiar to the field of nuclear energy, (2) those used in this field in a different sense or with a different emphasis from what is most commonly used in other connections, and (3) those used elsewhere in the same way, but so infrequently as to be unfamiliar.

2851 Alterations in Thermal Fragility of Rat Erythrocytes Following Total Body X-irradition. Leontine Goldschmidt, Robert L. Rosenthal, Victor P. Bond, and Maurice C. Fishler. Naval Radiological Defense Laboratory Report No. AD-199(B), Feb. 14, 1950, 12p.

A review of the literature has revealed indirect evidence that radiation affects the integrity of the circulating red cell, but that no direct change has been demonstrated. A spectrophotometric method for the quantitative measurement of red cell hemolysis produced by an elevated temperature (53°C) has been developed. By this method, a definite increase in red cell fragility was demonstrated in rats within 4 to 12 hr following their exposure to total body x-irradiation at 500 and 600 r. The possible mechanism of these red cell changes and their significance in radiation sickness are discussed. 11 references.

2852 The Effect of Total-Body X-irradiation upon the Hemolysin Response of the Rat to Sheep Erythrocytes. Henry I. Kohn. ORNL-391, Oct. 14, 1949. 15p.

X-rays were administered to rats at various times during the week before and the 5 days after a single injection of sheep erythrocytes. When given at any time during this interval, 300 r (LD/50, 725 r) depressed the hemolysin titer, which is defined as the reciprocal of the dilution of plasma causing 50% hemolysis in a 0.7% suspension of sheep erythrocytes. A given dose of x-rays (175-850 r) became progressively less effective as the time of its administration

was delayed after the injection of the antigen. The data show that x-rays given either before or after immunization can inhibit antibody production. The effect of the x-rays upon antibody production always involved a decrease in the peak titer; and under certain conditions, the development of the depressed peak was delayed. Therefore in certain instances, the titer in the irradiated animal, at first below the control level, exceeded the control when the latter subsequently declined.

2853 American Association of Anatomists. Sixty-third Annual Session. Held at New Orleans on April 5-7, 1950. Anat. Record. 106, 167-318(1950) Feb.

Among the papers presented were the following: Effects of Tritium on Cells Cultivated in Vitro, Austin M. Brues and Agnes N. Stroud; The Effect of Local X-ray Irradiation upon the Development of Various Parts of the Body of the Young Mouse, V. V. Brunst, D. J. Barnett, and Frank H. J. Figge; A Study of the Time of Closure of the Ductus Arteriosus Utilizing Radiophosphorus, Newton B. Everett and Robert J. Johnson; The Autotransfusion of Labeled Rabbit Lymphocytes, R. S. Farr; Mineralization of Bones and Teeth as Shown with Radiophosphorus Autographs, C. P. Leblond and L. F. Belanger; A Theoretical and Technical Study of the Autographic Method for the Localization of the Radioelements, N. J. Nadler, R. Bogoroch, and J. Gross; Radioactive Iodine and the Nursing Mouse, Roberts Rugh; Selective Testicular Damage in Rats Due to X-rays, Samuel L. Shaver and Karl E. Mason; Movement of Macrophages in the Liver of the Mouse after Injection of Thorotrast, J. Walter Wilson, Elizabeth H. Leduc, and Joyce A. Corner; and Different Types of Tumors Observed in Treated and in Untreated Golden Hamsters, Hadley Kirkman.

2854 Biochemical Mutant Strains of Neurospora Produced by Physical and Chemical Treatment. E. L. Tatum, R. W. Barratt, Nils Fries, and David Bonner. Am. J. Botany 37, 38-46(1950) Jan.

Plating techniques and cultures have been developed which permit the efficient isolation of homocarytic strains of Neurospora crassa from uninucleate microconidia. With these techniques, x-radiation, ultraviolet radiation, bis- and tris-nitrogen mustards, and methylcholanthrene have been examined for their effects in producing biochemical mutants in Neurospora. Treatment with x-rays was carried out by placing a drop of a dense suspension of microconidia on the surface of solidified 4% agar in a petri plate and allowing the water to be imbibed by the medium. The layer of microconidia remaining was treated directly with x-rays; following an exposure to about 20,000 r, about 0.01% of the organisms survived. Treatment of either microconidia or macroconidia with nitrogen mustards induces mutations which appear quantitatively and qualitatively similar to those induced by irradiation; the types of biochemically deficient mutants obtained are described. No indication has yet been found for extranuclear control of biochemical deficiencies in Neurospora.

2855 Biological Effects of Radiation. H. Langendorff, H. Bauer, W. Luther, R. Schulze, and U. Henschke. In FIAT Review of German Science, 1939-1946: Biophysics, Part I, pp. 51-122. Boris Rajewsky and Michael Schön (senior authors). Office of Military Government for Germany, Field Information Agencies Technical, 1948 (in German).



In this article the authors review work done between 1939 and 1946 on biological effects of radiation. About 150 references are included. The following topics are covered in separate sections: (1) Effects of Radiation on Cells and Cell-Complexes; (2) Genetic Effects of Shortwave and Corpuscular Radiations; (3) The Effects of Radiation on Connected Tissue and Larger Organisms; (4) Ultraviolet Mutations; (5) The Biological Effects of Optical Radiation.

2856 Biologie. Hermann Holthusen. In FIAT Review of German Science, 1939-1946: Radiology, Diagnostic and Therapeutic, pp. 28-54. Hermann Holthusen (senior author). Office of Military Government for Germany, Field Information Agencies Technical, 1947 (in German).

This article is a summary and guide to recent German literature about the general biological effects of radiation. The topics dealt with include target theory and its application to the theory of mutations, cells, and cell division, the influence of the wavelength of the radiation, as well as its rate per unit time on the observed biological effects. The action of radiation on various parts of the body (skin, bones, marrow, blood, glands, nervous system) is described. 80 references.

2857 Effect of Body Exposure to X-rays upon Bone Marrow. C. Lutwak-Mann and F. W. Gunz. Biochem. J. 44, iii(1949) No. 2.

Rabbits irradiated with a single 1,000 r x-ray dose, and rats irradiated with a single 500 r dose were observed for 2 weeks following irradiation. Weight of the animals, gross and histological changes in bone marrow, bone marrow glycolysis and respiration, adenosine triphosphate, nucleic acid P determinations, and bone marrow mitotic figures were followed. Partial recovery was observed in hemoglobin content, mitotic figures, glycolysis, respiration and nucleic acid P.

2858 The Effect of Radioactive Phosphorus on the Growth of the Albino Rat. Morton M. Kligerman. Am. J. Roentgenol. Radium Therapy 63, 380-95(1950) Mar.

Five groups of 21-day old Wistar Institute white male rats received $P^{32}$ on the following basis: Group A (24 rats) 44 $\mu$c/kg body weight; Group B (24 rats) 132 $\mu$c/kg body weight; Group C (24 rats) 400 $\mu$c/kg body weight; Group D (24 rats) 1,200 $\mu$c/kg body weight; and Group E (20) rats 3,600 $\mu$c/kg body weight. Five more groups of rats, 42 days old, received corresponding doses. Other details of the experimental procedures are included. It was found that doses as small as 44 $\mu$c/kg of $P^{32}$ retarded normal weight gain in the 21-day old rats; doses of 132 $\mu$c retarded the growth of bone (femur) and larger doses produced a greater effect; 44 $\mu$c/kg seemed to accelerate the growth. The effect of $P^{32}$ on growth (weight and long bones) ceased when its concentration fell below a threshold dose; this level was reached within 42 days after the last injection. The effect of the $P^{32}$ was found to be temporary, treated rats equaling normal rats in weight, size, and appearance when 300 days old. However, when 1,200-3,600 $\mu$c/kg was given, the physical appearance and activity of the rats were affected, and half of the 42-day old rats receiving 3,600 $\mu$c/kg died

before reaching 112 days of age; the 21-day old rats showed depression of all the cellular elements with profound changes in the white blood count. An increase in the densely calcified area on the metaphyseal side of the epiphyseal line also appeared.

2859 Effect of Transplantation of Bone Marrow into Irradiated Animals. Paul E. Rekers, Molly P. Coulter, and Stafford L. Warren. Arch. Surg. 60, 635-67(1950) Apr.

The results of the transplantation of marrow suspensions, bone and marrow and ribs, are presented; in some cases bone slivers were transplanted to the anterior chamber of the eye, or the liver or spleen, but usually the material removed from a normal dog was transplanted to the same location in an irradiated dog. A single dose of 350 r of whole body irradiation was given to the test dogs before the transplantation; similar experiments were performed on rabbits. It was found that the transplantation of the normal marrow to intramedullary marrow sites was without appreciable benefit to the irradiated animals. The transplantation of bone and marrow resulted in the death and replacement of the graft; transplantation of the normal marrow to normal or irradiated spleen or liver was also without benefit. Other results are outlined.

2860 Effect of X-rays on the Migration of Cells from Adult Tissue Explants. R. S. Hoffman and S. H. Wollman. Proc. Soc. Exptl. Biol. Med. 70, 38-40 (1949) Jan.

To test the effect of radiation dosages on the latent period before the appearance of cell migration, tissue preparations from adult chicken cardiac muscle were irradiated at a rate of 25 r/min by a 180-kv machine, filtration of 0.5 mm Cu and 1.65 mm Al, at a distance of 50 cm giving a total dose of 0 to 500 r. Results are presented graphically showing the per cent of explants showing a single migratory cell between 15 and 45 hr after irradiation and the variation of time before appearance of a migratory cell with the dosage. The authors conclude that irradiation with less than 30 r stimulates migration of cells from fresh explants and, irradiation of more than 30 r shows a gradually more extended latent period; this suggests a superimposed inhibition, which does not exceed the excitation effect until dosages go over a 1000 r level.

2861 Modification of the X-ray and Ultraviolet Induced Mutation Rate in Aspergillus Terreus by Pretreatment with Near Infrared Radiation. C. P. Swanson, Alexander Hollaender, and B. N. Kaufmann. Genetics 33, 429-37(1948) July.

To determine the effect on mutation rates of near-infrared irradiation from 250 w, 115 v sources, filtered by 1.5 cm of iodine saturated $CCl_4$ and heat resistant glass filters, spore suspensions of Aspergillus terreus were continuously irradiated for 3 days after which they were x-irradiated by two Coolidge-type tubes operating at 170 kv, with 0.25 mm Cu and 1.06 mm Al filters delivering 8,500 r/min for 1 to 20 min., or were irradiated by ultraviolet light delivered at 15 w, 115 v with a 90% radiation below 3,000 A. The per cent mutation rates for ultraviolet or x-irradiation alone are compared with rates for these combined with infrared pretreatment. The data and results are given and extensively



discussed. The authors conclude that with x-ray induced mutations infrared pretreatment causes a significantly increased mutation rate throughout the range tested, but that this does not effect the mutation induced by low ultraviolet doses although it does increase the mutation rate of high doses; an unknown mechanism is postulated whereby the mutated spores can utilize the infrared energy to recover and grow.

2862 New Forms of Eutorulopsis dubia Cif. and Red. Obtained through the Action of X-rays. Elisa Corberi. Boll. soc. ital. biol. sper. 25, 526-28 (1949)(in Italian).

Young cultures of Eutorulopsis dubia upon agar were submitted to the action of x-rays in successive doses of 15,000, 13,000, and 14,000 r. No notable changes in the aspect and in the number of colonies, as compared with the controls, were found. In a few cases colonies with a lighter than the usual shade of red color were observed, the individuals showing a slight increase in length. These modified forms, upon reproduction and further irradiation, gave birth to both modified and normal colonies. The modified forms proved so far stable; their sugar-fermentation power is the same as that of the normal form, while their catalase content is lower.

2863 On the Fermentation Properties of Eutorulopsis dubia Cif. and Red. Submitted to X-ray Action. R. M. Cioffi and C. Walter. Boll. soc. ital. biol. sper. 25, 529(1949)(in Italian).

By submitting Eutorulopsis dubia to the action of x-rays (15,000 r), Corberi (Boll. soc. ital. biol. sper. 25, 526(1949)) obtained a form differing in pigmentation from the normal one. In order to ascertain that the observed modification was not due to a mere change in the metabolism, the authors tested the reactive power of the new form in the processes of dis-amination and fermentation of aminoacids. The tests demonstrated the identical action on glycocoll of both the normal and the irradiated forms.

2864 Production of Malignant Tumors in Rats with Radioactive Phosphorus. Simon Koletsky, Frederick J. Bonte, and Hymer L. Friedell. Cancer Research 10, 129-38(1950) Mar.

Adult white male rats of the Wistar strain, weighing about 150 g, were used in experiments in which the incidence of neoplasms was observed following either the injection of a $LD_{50}$ dose of $P^{32}$ (4.5 $\mu$c/g of body weight) or repeated injections of $P^{32}$ (1.5 $\mu$c/g body weight every three weeks) for a total dose of 9 or 12 $\mu$c/g; spontaneous bone tumors have not been observed among control animals of this strain. Complete autopsies were performed on all rats which died or were sacrificed, and in almost all the animals routine microscopic sections of the femur and vertebrae were taken. Of the 19 animals in the first group, 9 developed malignant neoplasms but were otherwise in good condition, except for the last few weeks of life. Of 15 rats in the second group, 4 were discarded, and of the remaining 11, 4 developed neoplasms. Of the total of 13 neoplasms, 3 were squamous-cell carcinoma involving the face and were associated with exophthalmos; 10 were osteogenic sarcomas, 4 of which were located in the jaw, 2 in the spine, 2 in the tibia, and 1 each in the femur and pelvis; 4 of these latter tumors

metastasized to the lungs. The incidence of tumor development was about 40%. A typical proliferation of bone was usually found in the rats and the lesions, it is concluded, may have served as a precursor to malignant change.

2865 The Production and Some Properties of Clostridium perfringens Hyaluronidase. Sanford O. Byers, Alfred A. Tytell, and Milan A. Logan. Arch. Biochem. 22, 66-86(1949) May.

As a part of extensive experiments on production and properties of hyaluronidase, the enzyme was irradiated with x-rays having the greatest intensity at the $K_\alpha$ line of copper, 1.54 A wavelength, at a distance of 3 cm from the focal spot of the Cu target. As much as 4 hr exposures failed to inactivate filtrates; when the material had been purified by alcohol precipitation at its isoelectric point at −10°C, a similar radiation dose reduced the activity by 90%.

2866 Quantitative Aspects of the Protective Action of Cysteine Against X-radiation. D. E. Smith, H. M. Patt, E. B. Tyree, and R. L. Straube. Proc. Soc. Exptl. Biol. Med. 73, 198-200(1950) Feb. (See also NSA 4-378 and 4-379.)

Three groups of male Sprague-Dawley rats received a 10% solution of cysteine intravenously and within 5 min after the dose were irradiated by whole body exposure at 250 kv through a filter of 0.5 mm Cu and 3.0 mm Bakelite at a target distance of 26.5 cm with a dose rate of 210-220 r/min. Each group had controls and they were divided into groups as follows: 50-950 mg/kg of cysteine was given in graduated doses to test protection from 800 r and 1,000 r; the protective value of 950 mg/kg of cysteine was determined for graduated doses from 600-1,800 r; a dual injection composed of one dose of 475 mg/kg followed in 45-60 min by a second dose of 950 mg/kg was given and then the animals were irradiated as before with a total dose of 1,200 r. Results are briefly given and discussed and the authors conclude that the protection given by cysteine is roughly proportional to the amount of cysteine given.

2867 Quantum Physics and Statistics in Biology. M. Schön, B. Rajewsky, K. Sommermeyer, and H. Friedrich-Freksa. In FIAT Review of German Science, 1939-1946: Biophysics, Part I, pp. 1-49. Boris Rajewsky and Michael Schön (senior authors). Office of Military Government for Germany, Field Information Agencies Technical, 1948 (in German).

This review article is primarily a guide to the literature of quantum physics and statistics in biology. Approximately 150 references are given. Separate sections deal with quantumtheoretical features of biological problems; foundations of the target theory of the biological effect of radiation; further development of target theoretical concepts; energy migration in molecule complexes and structural units; forces which play a role in the composition of biological structural units.

2868 Thirty-first Meeting of the German Society for Roentgenology and Radiation Research. Held at Hamburg on Sept. 8-10, 1949. Aerztl. Forsch. 4, II/7-II/11(1950) Jan. 10 (in German).

Among the papers presented were the following: New Results of Radio-Biology, Forssberg; Results of Radiology in



Spain, Otte; Analysis of the Radio-Biological Effects of the Fast Electrons of a 6-Mev Betatron, Dittrich; Effects of Fast Electrons on Mitotic Processes, Schmermund; Results of Electron-irradiation of Mouse Tumors, Bleek; Erythema Effects of Fast Electrons, Kepp; Concerning Betatron Therapy of Human Tumors, Bode; Concerning New Results of Biological Experiments with Ultra-hard Radiations, Wachsmann; Roentgen Hemolysis as a Structural Problem, Lindemann; New Promising Roentgen Therapy of Trigeminal Neuralgia, Krautzun; New Indications for Small-Field Cyclotherapy, Spiegel; Clinical Experiences with Oscillation Therapy of Tumors, Kohler; Results of Roentgen Therapy with Very Small Doses, Pape; Short-Distance Radiation, Hammer; On Short-Distance Irradiation of Lupus Carcinoma, Kautzky; Results of Development and Tasks of Modern Roentgen Technique, Fehr; A Combination Gynecological-Radiological Instrument for Radium Therapy, v. Held; The Standpoint of Technique on the Question of a Standardization of Radium Applicators, v. Gorup; The Convergent Irradiation Device of Siemens, a Roentgen-Ray Source with an Extremely High Deep-Dose Percentage, Bischoff; Could the Results of Roentgen-Ray Source with an Extremely High Deep-Dose Percentage, Bischoff; Could the Results of Roentgen Therapy be Materially Bettered through Treatment with Cytostatic Material? Lings; and The Influencing of Vegetative Body Functions through Roentgen Irradiation. Experimental Findings, Bürgel.

2869 Reduction of Mortality from X-radiation by Treatment with Antibiotics. C. Phillip Miller, Carolyn W. Hammond, and Marianne Tompkins. AECU-738, nd. 6p.

Previous experiments (AECU-739) have suggested that infection might be a significant factor in death from radiation injury. An attempt has therefore been made to reduce the mortality from x-radiation by controlling the bacteremia by the administration of antibiotics. Treatment with streptomycin alone or combined with penicillin caused a significant reduction in the mortality (30 days) of mice following total body x-radiation with 450 r. Chloramphenicol although somewhat less effective was the best of the other antibiotics tested.

2870 The Incidence of Bacteremia in Mice Subjected to Total Body X-radiation. C. Phillip Miller, Carolyn W. Hammond, and Marianne Tompkins. AECU-739, nd. 9p.

Male, white mice of a strain having an $LD_{50}$ (30 days) of approximately 400 r were subjected to total body x-radiation in a single exposure of 600 or 450 r. Cultures of hearts' blood and spleen were made on mice killed at daily intervals post-irradiation. The results showed that bacteremia occurred most frequently during the period of greatest mortality, and its incidence roughly paralleled the daily death rate. Among the mice receiving 600 r the incidence of bacteremia reached a maximum of 85% on the 9th day post-irradiation, and among the mice receiving 450 r a maximum of 54% on the 10th day. With few exceptions the bacteria were all members of the species normally inhabiting the lower intestinal tract of this strain of mice. (auth)

2871 Safety Manual; 2nd Edition. Brookhaven National Laboratory. M-4484, Oct. 1949. 75p. (see also NSA 3-2095.)

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This Laboratory Safety Manual includes the procedures and policies relative to safety officially approved by the Central Safety Committee. It was issued in preliminary form in the spring of 1948 and has now been extensively revised. It is treated in 2 parts: radiation safety and general safety. A bibliography of references on radiation protection is included.

2872 An Improved Film Badge Method for the Accurate Determination of Personnel Exposures. Rachel Baker and Louis B. Silverman. UCLA-53, Feb. 10, 1950. 25p.

Experimental work on a more accurate and simpler method of film badge monitoring on this project has resulted in the development of an improved film badge technique. The new badge consists of a combination of lead and silver filtration which utilizes the mass absorption coefficient relationship of the two metals wherein there is a double crossover. Distinctive images are produced which make possible visible identification of 4 types of exposures. Widely separated density ratios of two areas on the same badge provide a means of identifying the energy of the $\gamma$ radiation and the quantitative mr proportion of contributing energies in mixed-exposure badges. A directional factor for location monitoring is provided, and the calibration time is greatly decreased because 1 calibration curve serves as a master for 3 different curves that were formerly made separately. (auth)

2873 Ballistic Roentgentherapy. Gaston Daniel. J. Radiol. Electrol. 29, 486-90(1948)(in French).

In consideration of the incidence of irradiation injuries and accidents caused by misuse of x-irradiation, the author discusses the possibility of aberrant rays which are not filtered or shielded from the tissue causing such conditions as cystitis, rectitis, colitis, sterility, pulmonary complications, and various irreversible radiation reactions. On this basis the optimum voltage, filters, and distances for tissue sterilization, suppuration drainage, chronic inflammations, and malignant and benign tumors are given. For tissue sterilization, radiation is delivered at 110 kv, 0.0-0.1 mm Al filter, giving a dose of 1,300 to 1,600 r over a strictly limited field; for suppuration, three daily series of 150 to 300 r delivered at 35 to 40 kv through 0.5 mm Al in small fields or delivered at 85 kv through 2.5 mm Al to large volumes of tissue, is given; for cancers of various types irradiation is delivered at 35 to 200 kv through up to 2 mm Al at various distances and for various dosages depending on the type. Special consideration is given to the diffusion of the rays, filtering, half-absorption layers, radiation homogeneity, and the total irradiation as compared to the aberrant irradiation at various voltages.

2874 Calculations for Maximum Permissible Exposure to Thermal Neutrons. Walter S. Snyder. Nucleonics 6, 46-50(1950) Feb.

This paper is primarily concerned with the calculation of the collision density of thermal neutrons as a function of depth. The permissible neutron flux is determined from the results of this calculation by a method similar to that used by earlier workers. No attempt is made to examine critically the biological assumptions, listed by the author, which are implicit in this method. It is concluded that the critical flux of thermal neutrons lies between 1,712 and 1,951 neutrons/$cm^2$/sec.

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2875 A Contribution to the Study of Transient Pleuro-Pulmonary Modifications Occurring after Radiotherapy of Breast Carcinoma. R. Sarasin, G. Voluter, and J. Garcia-Calderon. J. Radiol. Electrol. 29, 445-52(1948)(in French).

Nine case histories of pulmonary complications developing after the use of radiation of up to 12,000 r on breast cancer are given with radiographs of the affected area. Exudation with atelectasis is always a part of the symptomological picture; irritation of various types is reported and the histopathology of the mechanisms is discussed. These phenomena may be accompanied by a fibroid formation but are always transient in nature, appearing at times some months after irradiation and regressing after variable periods of time. It is mentioned that the radiological picture may resemble a pulmonary tumor.

2876 Cyanide Protection Against X-irradiation. Z. M. Bacq, A. Herve, J. Lecomte, and P. Fischer. Science 111, 356-7(1950) Apr. 7 (Technical paper).

Mice of pure breed (C 57 black or A.K.A.), weighing about 30 g and 4 to 6 months old, were irradiated by groups of 10, using 230 kv, 12 ma, copper filter 0.25 mm, focal distance 50 cm, field 100 $cm^2$, mean output 30 r/min. The 42 control mice receiving 500 to 600 r all died between the 4th and 8th or 9th day. Animals receiving 0.1 mg NaCN just before similar irradiation showed 50 to 80% survival. The same dose of NaCN given immediately after irradiation only delayed mortality. When the cyanide was injected 15 min after irradiation, the mortality curve was exactly the same as that of the controls. This protective action is attributed to the CN anion, and the possible modes of action of this protective factor are discussed.

2877 Diseases of the Hands and Nails. Arthur C. Curtis and Lewis W. Kirkman. Oral Surg. Oral Med. Oral Pathol. 3, 289-355(1950) Mar.

This article discusses in detail and under separate headings the symptoms and treatment of a variety of diseases of the hands and nails (virus, pyogenic bacteria, fungus, moniliasis, tinea, blastomycosis, sporotrichosis, syphilis, scabies, tuberculosis, psoriasis, tularemia, carcinoma, eczematoid eruptions, allergy and occupational dermatoses, and also special diseases of the nails). Among the conditions discussed is radiodermatitis. The authors point out that the only significant difference between the skin reaction following exposure to x-rays and that following radium is a superficial ulceration of the epidermis frequently seen with the latter, and due to the emitted alpha and beta particle (filtered radium applications not exhibiting this phenomenon). The manifestations of the chronic and acute forms of radiodermatitis are outlined; treatment is surgical if the burns are severe and adequate drainage, proper immobilization, and skin grafting at an early date are considered to be very important.

2878 Disposal of Radioactive Wastes by Biological Methods. I. C. C. Ruchhoft. Atomics 1, 12-15(1949) Aug.

Reasons are given for preferring the activated sludge process to the trickling filter process in applying biological techniques to radioactive problems. The principles governing the sludge process are outlined, with emphasis on the important part played by zoogloeal bacteria. In ex-

periments on Pu solutions it was found that sludge treatment for 24 hr reduced the activity in the liquid from ~$10^5$ c/min/liter to ~4,000 c/min/liter. (auth)

2879 Damages by Radiation. B. Rajewsky, A. Schraub, G. Kahlau, W. Dreblow, A. Krebs, and H. Schaefer. In FIAT Review of German Science, 1939-1946: Biophysics, Part I, pp. 123-75. Boris Rajewsky and Michael Schön (senior authors). Office of Military Government for Germany, Field Information Agencies Technical, 1948 (in German).

Radiation injuries are discussed under the following headings: (1) Lethal Dosage Curves; (2) Production of Cancer by Radiation, Especially as Observed in the Radium Mines at Schneeberg; (3) Changes in Blood Produced by Radiation; (4) Radium Poisoning and Its Physical Diagnosis; (5) Measurement of the Content and of the Distribution of Radioactive Substances in the Body; (6) Radiography and the Counting of Single Particle Tracks as Used in Radiobiology. 90 references.

2880 The Effects of the Atomic Bombs at Hiroshima and Nagasaki. British Mission to Japan. nd. 39p. (AEC File No. NP-1156.)

This official mission of the British government spent the month of November, 1945, in Japan studying the effects of the two atomic bomb raids. Chapters depict the two cities before and after attack. The blast, heat, and radiation effects of atomic bombs are discussed. An estimate is made of the possible effects of atomic bomb attacks on British urban areas.

2881 Experimental Study of the Air Ionization Produced by a Certain Radioactivity of the Soil; Its Effect on Human Health. P. Cody. Bull. soc. sci. Bretagne 23, 69-76(1949)(in French).

With the aid of an ionization chamber or a photographic plate, placed in the neighborhood of the soil, radiations can be detected that are localized in certain spots of the soil surface (0.5 to 2 m in diameter) and show diurnal and seasonal variations. They are probably $\alpha$ particles emitted as a result of radioactive processes in the soil. Various physiological and pathological effects due to the "telluric radiation" are mentioned. No critically conceived and methodically made observations are presented.

2882 Health Physics at Oak Ridge. Karl Z. Morgan. Nat. Safety News 61, 24-25, 93-96(1950) Apr.

This article describes in general terms the hazards encountered in work with radioactive substances, as well as the safety measures adopted at the various installations of the atomic energy commission. Some information is given concerning the safety record achieved.

2883 Medical Aspects of the Atomic Bomb. G. M. McDonnel. Ordnance, 308-10(1950) Mar.-Apr.

Atomic casualties, which are produced as a result of blast, heat, and ionizing radiation, are discussed. The relative value of these agents determined by a scale of biological significance will vary primarily with the type of detonation, namely, in the air, on or near the ground, and under water. With an air detonation, the ranges of the blast and thermal effects are distributed over the greatest possible area. In the ground detonation the ranges of blast, heat, and ionizing radiation are less than the air-detonation values. The heat and initial ionizing radiation produced as a result of an underwater detonation are largely contained within the surrounding water. It is stated that the danger from radiation has been highly overrated.



2884 Post-Radiotherapeutic Esophageal Stenoses. R. Nadal and J. Piequet. J. Radiol. Electrol. 29, 296-7 (1948)(in French).

Three cases of stenosis occurring after x-irradiation which included the esophageal region as a part of the field are presented in detail. Irradiation was delivered at 180 to 200 kv, through a 1 mm Cu and 2-3 mm Al filter, at a focal distance of 40 to 50 cm, giving single doses of 200 to 250 r at varying intervals, with a total dose between 3,000 r and 12,000 r. The stenoses, involving skin area fibroid formation, developed progressively after variable periods; in these cases all other causes of the reaction are eliminated.

2885 Protective Materials for Field Definition in Radiation Therapy. E. Dale Trout and R. M. Gager. Am. J. Roentgenol. Radium Therapy 63, 396-408(1950) Mar.

Transmission data were taken for lead, brass, steel, lead rubber, lead glass and plate glass over a range of 60 to 2,000 kv peak at various filtrations. The data have been plotted in the form of graphs for all the conditions studied and tables are included which show the thickness of the various protective materials for transmission of 10, 5, 1, 0.5 and 0.1% radiation.

2886 Shielding Against Radiation and Tolerance Dose. M. Dorneich, R. Jaeger, H. Schaefer, H. Muth, U. Henschke, and B. Rajewsky. In FIAT Review of German Science, 1939-1946: Biophysics, Part I, pp. 177-226. Office of Military Government for Germany, Field Information Agencies Technical, 1948 (in German).

This article contains, among others, sections devoted to the following topics: tolerance dosages for various kinds of radiation; protection against x, $\gamma$, and $\beta$ rays; and protection against neutrons. The use of concrete walls for shielding against neutrons is described in some detail, with some calculation on the scattering and slowing down of the neutrons by concrete. Satisfactory results are described which were obtained with the use of a special kind of concrete containing boron and thus having an especially high capture cross section for neutrons. 60 references.

2887 The X-ray Technician and the Atomic Age. Ellis J. Wick. X-ray Technician 21, 284-5, 287(1950) Mar.

A general discussion is presented on the history of, nature of, and defense against ionizing radiation, and the role of the radiological technician during atomic warfare is outlined. The author points out that the radiological technician with the direction of the radiologist would be assigned the duty of training the population for atomic defense; the defense would consist of (1) training, organization, and distribution of personnel, (2) development of fixed structures to withstand a tolerance dosage, and (3) instruction in the use of detection equipment, protection and removal of exposed personnel, and decontamination. Various improvements,

connected with radiology, to be expected in the future are briefly presented.

2888 Human Radioautographs (Automammographs, Autohepatographs, Autoangiographs, etc.) Obtained with the Aid of an Artificial Radioisotope ($Zn^{65}$). J. H. Muller. J. Radiol. Electrol. 30, 290-3(1949)(in French).

Autoradiographs of the breast, liver, and major vessels were demonstrated in patients with various histories of malignancy after injection of 100 mc of $Zn^{65}$ intravenously in the form of the oxide. This method, the author concludes, may show certain elements of the metabolism of the organs and may lead to the use of radioactive isotopes for therapy when more data on specific metabolism are available. The roentgen dosage is estimated to be 14 r/g for ionization particles and $\gamma$ rays. This method for diagnosis is considered valuable.

2889 Beta Irradiation of the Eye Using the Radium-D Applicator. Part II. Clara L. Okrainetz. Am. J. Ophthalmology 33, 52-62(1950) Mar.

The results of the treatment of 26 cases of corneal opacity with vascularization, 19 cases of pterygium, 2 cases of chronic corneal ulcers, 13 cases of keratitis, and 4 cases of vernal catarrh are presented. A radium-D applicator was applied for a total dosage of about 5,000 to 15,000 r equivalents, varying widely for the individual cases. The symptoms and duration, therapy, and results are tabulated for each case. The results of the therapy lead the author to conclude that the radium-D applicator is an effective source of $\beta$ irradiation and the applicator has proved to be a valuable adjunct in the treatment of benign lesions of the superficial structures of the eye. In no case treated was there injury to the underlying or adjacent tissues.

2890 Cancer of the Cervix Uteri; A Review of 296 Cases, 1935-1944. John F. Hynes. Am. J. Radiol. Radium Therapy 60, 368-81(1948) Sept.

An analysis of 296 cases of cervical carcinoma is given with respect to pathology, determinacy, stage of the disease, race, symptoms, other diseases accompanying the cancer, survival rate, age, symptom duration, associated syphilis and pregnancy histories, and therapy. Contraindications for radiation, such as radiation sickness, severe erythema or sloughing, age, obesity, and complicating diseases, are discussed; such symptoms as anemia, infections, cystitis, proctitis, and colitis may occur. Radiation sickness is effectively treated with amphetamine and desoxy-ephedrine. The roentgen doses were delivered in most cases by a 200-kv machine through a 0.5-mm Cu filter at a distance of 70 cm, 5 to 6 days/week, through alternating anterior and posterior pelvic regions; 200 r/field was given through 4 fields/day, for a total optimum dose of 2,400 to 3,000 r/field. Transvaginal irradiation used in some cases was delivered by a 140-kv machine, unfiltered, in doses of 400 to 500 r/treatment for a total of up to 2,000 r through each lateral fornix. Radium tandens were placed in the uterine canal, 50 mg in the cervical canal and 25 mg in the lower corpus; the filtration was 1.0 mm Pt, and a total of 4,500 to 6,000 mg-hr was delivered, plus 20% in cases which include the fundus. A colpostat and parametrial needles were used in some cases. Four cases of death from radiation and one from technical errors are reported; colitis, bladder ulceration, fistulas, pyometria, and skin and bone complications are discussed. A 3-year survival of 57% of all cases and 75% of operable cases was obtained; a 5-year survival of 51% of all cases and 71% of operable cases is reported.

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2891 Carcinoma of the Anal Canal; Statistics of the Foundation Curie, Paris. J. L. Roux-Berger and A. Ennuyer. Am. J. Roentgenol. Radium Therapy 60, 807-15(1948) Dec.

The results of radiation treatment of 51 cases of anal carcinoma are analyzed in terms of the character of the lesion, technical and therapeutic errors, lymph node metastases, histopathology, concurrent surgical procedures, and types of radiotherapy used which include radium application and implantation, intracavitary teleradium applications, and roentgen-ray therapy. In cases in which radium was used there were 16 five-year cures out of 24 cases, and out of 51 receiving some type of radiation, there were 8 cases of radionecrosis as a result of excessive irradiation (more than 18 mc). The later use of roentgen rays delivered by a 500-kv machine at 5 cm is found to increase the tissue dose 15% over the usual 200-kv irradiation. The authors conclude that, on the basis of 18 five-year cures, anal carcinoma is radiosensitive, and radiotherapy is the only method of avoiding permanent colostomy.

2892 Carcinoma of the Larynx. F. Baclesse. Brit. J. Radiology, Suppl. No. 3, 1-68(1949).

The results of the radiotherapeutic treatment of 341 cases of epithelioma of the larynx are presented in this extensive article. Of these, 299 cases were treated by x-rays, and 42 were treated with teleradium; the results of the latter technique were very poor and are not discussed. The x-radiations were delivered by a 180- to 250-kv machine, with a filtration of 1 mm Cu at a focal-skin distance of 50 to 60 cm and a dose rate of 15 to 20 r/min; the field, dose, and the time intervals between treatments varied considerably. The skin dose for lesions confined to the true cord (and not impairing its mobility) was relatively small, 6,000 to 7,000 r, or about 3,000 to 3,500 r tumor dose for the average size neck; more extensive radioresistant lesions with glands required a total skin dose of 8,000 to 12,000 r. There was a 19% cure rate (five-year results or more) for those lesions treated by the x-ray method. An appendix containing an additional report on 216 cases and prepared by R. W. Gunderson is also presented.

2893 Caustic Radium Therapy or $\beta$-Ray Therapy. Paul De Plaen. J. Radiol. Electrol. 29, 264-7(1948)(in French).

After a review of Ra disintegration, the author compares radium to x-ray at various distances, energies, and filters and discusses the absorption of 50 and 99% of the incident energy by tissues and various filters as a function of the depth. The biological action of the rays emitted is extensively considered with respect to the therapeutic use of radium applications in cases of epitheliomas and neoplasmas of the rectum, uterus, larynx, and urethra; dangers and precautions involved in radium application therapy are discussed.

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2894 Chronologically Fractionated Dosage of Irradiation. P. Marquès. J. Radiol. Electrol. 30, 30-5(1949) (in French).

A discussion is given of the use of a single dose in radiotherapy which will destroy or mutate the tumor, but which will also cause erythema, depilation, or radiodermatitis. Fractionated doses given at regular calculated intervals resulting in the same total dose may reduce danger of these effects by allowing the reversible reactions in the irradiated cells to recover, while the irreversible reactions (those thought to be destructive to the tumor, such as mutation and tissue necrosis) remain at a constant level. Graphs of energy present in the tissue show exponential decay after the dose, so that by proper calculations the author concludes that it is possible to avoid undesirable reactions. Other calculations involving the energy absorbed should enable a dose to be delivered at maximum radiosensitivity which depends on the mitotic state of the cells of the tissue. Various methods of radiotherapy are described in terms of these considerations, especially those used at the regional center at Toulouse.

2895 Cineradiotherapy. J. Jalet. J. Radiol. Electrol. 29, 583-8(1948) (Technical note, in French).

The technique of cineradiotherapy (whole-body or wide-field radiation therapy) and procedures for measuring radiation delivered from sources at 20 to 350 cm situated at various locations are described in detail. The dose received in roentgens ($D'_r$) is measured by X x l/L, where X is the amount of radiation delivered by the machine under rest conditions, l is the length of the field through which the machine or the patient moves, and L is the skin to tube distance. This method is considered especially applicable to inoperable cancers, especially cutaneous cancers with metastases in viscera, bone, blood, endocrine tissue, and other skin areas due to its maximum absorption on large surface areas; it is preferred to teleradiotherapy for these conditions.

2896 The Concepts and Clinical Manifestations of Systemic Diseases. Gustavo Montejo. Bol. inst. nacl. Radium 1, 253-494(1949) Mar.-July.

This extensive article discusses various aspects of neoplasms and metastases, including the classical conceptions of the mechanism of neoplasms, the functions of reticular tissue, and human adaptive processes, and presents the results of the radiation treatment of lymphosarcoma, follicular lymphoblastoma, malignant lymphogranulomatosis, multiple myeloma, and myeloma. The complete case histories are presented on the subjects treated. 60 references.

2897 The Division and Measurement of Surface Doses in Orthokinetic Radiotherapy. P. Jacob. J. Radiol. Electrol. 30, 227-9(1949)(in French).

This is a discussion of the surface dose given in irradiation and the necessity for its measurement. Graphs describing the per cent of the central dose in terms of the per cent of rays present in the total irradiated circle and in terms of the per cent of the diameter of the irradiated circle are given.

2898 Dosage Distribution and Dosage in Carcinoma of the Uterine Cervix. W. J. Meredith. Radiology 54, 386-90(1950) Mar.

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A method is described for the adequate irradiation of cases of carcinoma of the uterine cervix by means of radium and x-rays, and the results of the treatment of 2,429 cases from 1934-1944 are presented. Radium applicator tubes were inserted in a line in the uterus, and one was also placed in each lateral fornix; x-radiations were delivered through eight 10- by 4-cm fields at 40 cm target distance with a 250-kv machine. The present method consists in treating stages I and II of the disease with radium for 3 days for a total of 4,000 r to point A (a point 2 cm lateral to the central canal of the uterus and 2 cm from the mucosa of the lateral fornix); after an interval of 4 days, 4,000 r is again delivered in 3 days to point A, for a total of 8,000 r. In cases in stages III and IV, radium is given for 3 days for a total of 3,500 r to point A; x-rays are then delivered for the next 24 days for a total of 2,400 r to point A; and radium is again given for 3 days and a dosage of 3,500 r. In this manner a total dosage of 9,400 r is delivered in 5 weeks. The 5-year survival rate for these cases has increased from 26% in 1934-1935 to 38% for 1942-1943. This method is advantageous, conclude the authors, because it is simple and adaptable, and because it enables an easily determinable dose of r to be delivered to any patient.

2899 Dose Measurement. M. Dorneich, R. Jaeger, H. Krefft, and H. Muth. In FIAT Review of German Science, 1939-1946: Biophysics, Part I, pp. 227-57. Office of Military Government for Germany, Field Information Agencies Technical, 1948 (in German).

Dosimetry of x-rays, neutrons, and radium emanations is discussed, especially from the point of view of the efforts made in Germany to standardize dosimetric procedures for therapeutic purposes. In particular, the norms and units adopted by the German X-Ray Society are described (Normenblatt DIN Roent 9/1939, Berlin, Beuth Verlag). A large number of dosimetric experiments are summarized. 80 references are given.

2900 Early Results of Radiotherapy of the Cavum in Cases of Common Infection in Infants. Cl. Béraud. J. Radiol. Electrol. 29, 659-60(1948)(in French).

This is a commentary on 23 cases of infections of rhinopharyngeal origin in infants from 1 to 24 months of age, treated with x-irradiation delivered by a 120-kv machine, filtered by 2 mm Al at a focal distance of 25 cm in doses of 30 to 50 r/port through 3 ports (anterior center of the nasal pyramid, and 2 lateral oblique ports), giving a total dose in 12 days of 360 to 600 r. Other types of therapy used in conjunction with radiation are discussed; the results were good in 12 cases, doubtful in 6, and the infection was checked in 5.

2901 Foundations and Results of Electron Therapy with a 6-Mev Betatron. Gerhard Schubert. Schweiz. med. Wochschr. 80, 193-200(1950) Feb. 25 (in German). (See also NSA 3-2109.)

The author points out that irradiation by fast electrons has the advantage of large relative depth dosage. Because of the scattering of fast electrons in tissue, the dosage first increases with depth, reaches a maximum, and then rapidly decreases to zero at a distance corresponding to the range of the electrons. The radiobiological effect of fast electrons is in general somewhat smaller than that of x-rays because the ionization per unit path length is less. This is verified by

a number of experiments of the author and his associates, involving the irradiation with x-rays and electrons of barley seeds, bacteria coli, and Drosophila melanogaster flies. Electron radiation also differs qualitatively from x-rays in its biological effects; as an example, it is mentioned that in small doses up to 1,000 r it increases the growth of barley seeds. Some results are given concerning the treatment of 70 cases of carcinoma (of or near the skin) with electrons from a 6-Mev betatron, the dosage being 2,000 r, administered at the rate of 1,000 r/min. In all cases the primary symptoms were removed, and no damage was done to the surrounding healthy tissue. 27 references.

2902 Histologic Changes Produced by Radiation in Adenocarcinomas of the Uterus; Comparison with Changes Produced in Squamous Cell Carcinomas of Cervix. J. F. Sheehan and H. E. Schmitz. Am. J. Clin. Path. 20, 241-52(1950) Mar.

A study was made of the histological changes in 13 cases of adenocarcinoma of the uterus following radium and x-ray therapy. The x-ray therapy was usually delivered at 800 kv, and the radium therapy was given through a Y-shaped capsule introduced into the uterus; total doses of x-rays and radium were roughly 4,000 to 7,000 r or mg-hr, delivered in fractionated doses. A sequence of changes was observed, comparable to those found in irradiated squamous cell carcinomas. In addition, such special effects on glandular structures were noted as simplification of the glands, loss of glandular form, disintegration of glands, and inspissation of secretion with or without foreign-body giant cell reactions. (auth)

2903 Histologic Localization of Absorbed Radioactive Iodine in Some Human Thyroid Diseases. Frederick L. Kreutzer, Earl R. Miller, Mayo H. Soley, and Stuart Lindsay. Arch. Surg. 60, 707-20(1950) Apr.

The localization of $I^{131}$ in the thyroid glands of 35 patients having thyrotoxicosis with diffuse thyroid enlargement, nodular goiters, thyroiditis, or thyroid carcinoma was determined. An oral tracer dose of $I^{131}$, 250 $\mu$c free of carrier iodine, was given 1 to 5 days before operation; 24 hr later the total uptake of the isotope by the thyroid was determined; film exposures were made from sections of the radioactive gland. It was found that the isotope was taken up in the thyroid glandular tissue, appearing both in the acinar epthelium and in the colloid; the uptake usually varied directly with the degree of hyperplasia in a gland undergoing the hyperplasia-involution cycle. In the cases of thyroiditis, in one case of simple adenoma, and in one fetal adenoma, the isotope uptake was small. One of 15 carcinomas demonstrated significant $I^{131}$ uptake. It is concluded that radioiodine will probably be of limited value as a sole therapeutic agent for treating carcinoma of the thyroid. (auth)

2904 Hodgkin's Disease; a Histopathological and Clinical Classification with Radiotherapeutic Response. Philip F. Sahyoun and Stuart J. Eisenberg. Am. J. Roentgenol. Radium Therapy 61, 369-79(1949) Mar.

Hodgkin's disease is classified by histopathology into a compact cellular type, a fibrogranulomatous type, and a loosely cellular type, in order of decreasing life expectancy. Eleven cases of the first type were treated with radiation to pelvic, abdominal palpable gland, and other regions, and whole-body irradiation in doses of 200 to 6,400 r/region; 6 cases of the second type received radiation up to 17,000 r total dose; 7 cases of the third type received radiation in doses similar to those in the first type. The 24 cases are presented in detail, 19 of which were adequately followed; the results for the first type are satisfactory, for the second, inconclusive, and for the third, poor; one case of decrease in radiosensitivity is noted.



2905 Importance of Intravaginal Radiotherapy for the Treatment of Collum Carcinoma. M. Demoullin and R. Kepp. J. Radiol. Electrol. 30, 617-22(1949) (in French).

The amount of radiation delivered by the Schaeffer-Witte tube at 90 to 100 kv with Cu filtration is discussed in terms of the intensity at various locations. Three types of irradiation are given: radium doses of 4,000 mg-hr in two doses of 2,000 each, or one of 3,000 followed by one of 1,000, filtered through 0.5-mm Pt and placed in the cervical isthmus or fundus; vaginal irradiation of 2,400 r in twelve 200 r doses; and surface radiation of about 1,200 r, given through 3 portals: dorsal, ventral, and perineal. The total course of internal and external radiation is given over a 28-day period, so that a minimum of 4,000 to 5,000 r is absorbed by the tumor itself. Three cases of carcinoma of the uterine canal and one case of vagino-uterine sarcoma are cited in detail. The authors conclude that these methods show promise in the therapeutics of all types of vagino-uterine malignancies and, despite the difficulties, may be efficacious in otherwise untreatable cancers.

2906 Influence of Time Distribution in a Radiation Series on the Course of Post-operative Treatment of Breast Cancer. H. Dancot and G. Segers. J. belge radiol. 31, 288-95(1948)(in French).

The authors present the results of the treatment of cancer of the breast by two methods of radiotherapy. In both methods the x-radiations were delivered at 200 kv at a target distance of 40 cm and with a filtration of 1 mm Cu and 2 mm Al. The first method consisted in employing repeated small doses for a total series of 900 r, followed at 6-month intervals by two more 900 r series. The second method consisted in delivering two radiation series, the first of a total of 1,800 r and the second of 1,200 r 6 months later. The first method showed 22% recidivations after 1 year and 40.4% after 2 years; 1 year after the second method was employed there was 14.4% recidivation, and 36.5% after 2 years. The authors suggest that the results may be further improved by increasing the total dosage and reducing the series to one.

2907 Intra-Uterine Dosimetry in the Roentgentherapy of Neoplasms of the Neck of the Uterus. J. Reboul and J. Papillon. J. Radiol. Electrol. 29, 663-4(1948) (in French).

Two series of five cases each of collum carcinoma which were treated with radiation are presented. The first group received contact radiation delivered by a 200-kv machine filtered through 2 mm Cu and 2 mm Al with an average dosage of 250 r. Intensity measurements on the surface and intra-uterine show that 83 to 96.9% of the surface radiation penetrated through the uterus. The second series of experiments, using a different type of dosimetry for the same radiation, shows only 13 to 17.8% penetration. This variation in

results, the authors conclude, is a function of the dosimetry methods and gives extremely wide variation due to absorption by the dosimeter itself and other factors; the use of microfilm preparations is the preferred method since it shows the fractionation of energy and the discontinuity of limited response depending on the tissue structure.

2908 Malignant Tumors of the Superior Respiratory-Digestive Tract, Vol. I. J. Ducuing and L. Ducuing. Paris, Masson et Cie, 1949 (in French). 563p.

This is an objective study of malignancies of the superior respiratory-digestive tract. A review of the essentials of anatomy and physiology is given, followed by an extensive treatment of specific sites of tumors. The methods of therapy (surgery, radium, and x-ray) are critically discussed in relation to the authors' experiences in the Cancer Center at Toulouse; tables of statistics, both French and foreign, are given. The authors conclude that the three methods of treatment described, or a combination of them, are to be preferred.

2909 Manual of Roentgen Therapy. F. Pürzer. Stuttgart, Wissenschaftliche Verlagsgesellschaft m.b.H, 1949 (in German). 174p.

This book discusses the physical-chemical basis and the biological effects of x-rays on the organism; radiation sickness is described. In discussing the radiation methods, the requirements for the effective therapy of specific diseases are outlined, and details of the technique and dosimetry are included.

2910 New Technical Methods and Clinical Results with Contact-Therapy. Mario Ponzio. J. Radiol. Electrol. 29, 572-8(1948)(in French).

The author discusses the two machines in use and compares them in terms of dosage delivered in r/min for distances of 2.3 to 3.3 cm, Al filters of 0.1 to 1.6 mm, and tube distances of 0 to 52.5 mm for 40 to 70 kv. The differences in radiation delivered are divided into two classes: those which ionize the tissue by absorption of primary radiation, and those which ionize both the specific tissue irradiated and the peripheral tissue by absorption of the secondary diffuse radiation. The clinical use of radiation delivered at 40 to 50 kv without filter or at 50 to 60 kv with a filter of 0.1 to 0.5 mm Al in total doses of from 3,500 to 9,000 r for epitheliomas and lymphangiomas without metastases and in smaller doses of 800 to 1500 r for other types of lesions is discussed; some mention is made of the use of radiation delivered from a cylindrical tube, permitting insertions for contact radiation of endocavitarial lesions.

2911 Observations concerning a Combined Colchicine-X-ray Therapy of Leukemia. Edwin Keibl and Anny Lötsch. Schweiz. med. Wochschr. 80, 228-31(1950) Mar. 4 (in German).

The authors treated several cases of leukemia by first injecting subcutaneously 2 mg of colchicine and then irradiating the spleen of the patient with x-rays (dose 150 r, filtration 0.5, target distance 30 cm). By blood counts taken at ½-hr intervals after injection of the colchicine, the most suitable time for irradiation was found to be, in most cases, 2 hr after the injection. Three cases are described in detail. The authors conclude from them that, although colchicine by itself has no therapeutic value, it has the selective effect of making leucocytes sensitive to x-rays, thus greatly increasing the effectiveness of irradiation.



2912 Physical Study of Practical Dosimetry. Part II: Practical Formulae of Diffusion and Intensity of Pencil Transmission. J. Reboul. J. Radiol. Electrol. 29, 588-92(1948)(in French).

The author proposes a corrected formula which shows better agreement with experimental data than that of Gros for the determination of the dependency of intensity on focal distance. The intensity is given by the expression

$$I = I_0 e^{-\mu z}\left[\frac{d_2}{(z+d)^2} + \frac{K\,(z+d)^3 - d^3}{d^2}\right]$$

where d is the distance, $\mu$ is the coefficient of absorption, and K is an experimentally determined diffusion coefficient. The variation of intensity with the coefficient of absorption is given by an expression in the form $(A + B\mu)e^{-\mu z}$ where A and B are two experimentally determined values, with A determined by the surface field for small areas. The variation of the intensity of the diffuse rays is a function of the field also and is operationally determined by $A\,(1 - e^{-Ks})$. The variations of A and B with $\mu$ are given for experimental values, and the following formulas are taken from the experimental curves $B = n - p\mu^2$; $A = m - pe^{K\mu}$ where m, n, and K are experimental constants. Values of the penetration of the phantom for voltages of 120 to 200 kv dependent on its subjacent position are tabulated, and a minimum diffusion is discovered. An expression for penetration is determined which is more closely in agreement with the observations than others, having a form

$$(Az + B)\,e^{-\mu z - c\sqrt{z}}\left[\frac{d^2}{(z+d)^2} + K\,\frac{(z+d)^3 - d^3}{d^2}\right].$$

A review of previous work on the diffusion problem is given, followed by a discussion of the methods of attack which may be of use.

2913 Pigmented Villonodular Synovitis. Maurice M. Greenfield and K. M. Wallace. Radiology 54, 350-6 (1950) Mar.

The literature dealing with pigmented villonodular synovitis and its related variants is reviewed, and the results of the treatment of 5 cases with x-rays are presented. Dosages were variable, about 1,200 to 2,500 r to the affected regions, several series usually being given. All the cases discussed yielded to the therapy, and the patients were able to return to their occupations with little or no subsequent swelling or pain in the affected areas. The authors conclude that this type of therapy is the treatment of choice following exploratory arthrotomy and biopsy.

2914 The Present Status of Radioactive Isotopes in Medicine. Leonard A. Walker. J. Kansas Med. Soc. 51, 110-13(1950) Mar.

This paper presents some of the functional facts about radioactive isotopes, reviews some well-known clinical applications, and points out their possibilities and limitations. The radioisotopes are mentioned in connection with tracer techniques, diagnosis, and therapy; $P^{32}$ is noted as a therapeutic means for bone and blood conditions, $I^{131}$ measures the thyroid activity, and $Na^{24}$ is a means for measuring

the circulation time. Tritium, $H^3$, as a radioactive component of a therapeutic agent, is mentioned. Two examples of how radioisotopes have expanded our classical knowledge are the new concepts of the first stages of photosynthesis and the discovery of the dynamic role of fat in the living organism. The author concludes by envisaging greater use of the radioisotopes. 18 references.

2915 Primary Carcinoma of the Lung. A Clinical Study of 1205 Cases. Irving M. Ariel, Edward E. Avery, Lester Kanter, Jerome R. Head, and Hiram T. Langston. Cancer 3, 229-39(1950) Mar.

A total of 816 patients with primary carcinoma of the lungs received x-ray therapy, which usually consisted of a daily dose of 150 r to each of two portals delivered by a 200-kv machine having a 2-mm Cu filtration and operating at a target distance of 50 cm; a total dose of about 3,000 r was usually given. The average survival time after therapy was about 2.9 months. Other types of therapy are also discussed. In an attempt to evaluate the effects of the various dosages upon survival, some of the patients were divided into groups and received either less than 5,000 r, 5,000 to 6,500 r, or more than 6,500 r. It was found that those receiving 5,000 to 6,000 r yielded the best results, surviving an average of 4.7 months after the therapy. Palliation therapy may be administered by small doses of x-rays, interstitial radon seeds and needles, and, in certain circumstances, by nitrogen-mustard therapy. 45 references.

2916 The Problem of Radioactive Isotope Dosage in Therapeutic Applications. Beta-Ray Dosage. G. Joyet. J. Radiol. Electrol. 30, 310-17(1949)(in French).

The dose in equivalent r of radiation delivered by radioisotopes may be calculated by the expression $D^1_\beta = 61.2\, A_{\mu c/g}\ \bar{E}_\beta$ Mev $J_d$, where A is the average activity of the isotope in mc/g, E is the average energy of the beta rays emitted from the isotope in Mev, and J is a parameter which may be determined graphically from the expression $J = \int_0^t Se^{-0.693^t/T}\, dt$, where the time, t, is in days, and S is a selectivity factor of the particular tissue or organ determined by the ratio of the activity per gram of the organ to the average activity of the injection per gram of the whole body, and T is the period of the isotope which is equal to $0.693/\lambda$. Curves of S against time are plotted for various tissues such as blood, tumors, muscles, and intestine after injections of $K^{42}$; these are correlated to one case of a J plot; energy graphs of $\beta$ disintegration for $Ca^{42}$ and $K^{42}$ are given; a method of determining the average energy is developed, and the apparatus for necessary measurements is described.

2917 The Problem of Radioactive Isotope Dosage in Therapeutic Applications. The Dosage of $\beta$-Rays. Marcel Frilley. J. Radiol. Electrol. 30, 630(1949) (in French).

This is a note on such factors as the number of disintegrations, secondary ionizations, ionization density, particle trajectory, and equivalents of beta, gamma, and x-rays, which must be considered in setting up standards for measurement and expression of doses of radioactive isotopes, especially those used therapeutically.



2918 Radiation Therapy. Advanced Training Course in X-ray Therapy at Erlangen. H. Meyer and K. Matthes, Eds. Stuttgart, Georg Thieme Verlag, 1949. (in German). 374 p.

This book contains lectures given by various authors at Erlangen University. The subjects covered are the physical foundations of x-ray therapy, dosimetry, protection against radiation damage, the biological foundations of radiation therapy, and a detailed discussion of therapy for various diseases, among them tumors and carcinoma.

2919 Radioactive Isotopes in Therapy. A. Vannotti. Schweiz. med. Wochschr. 80, 123-5(1950) Feb. (in French).

The rationale of radioisotope therapy is briefly discussed and compared to x-ray therapy, especially in relation to hematological disorders such as leukemia and polycythemia vera. Acute leukemia, necessity for massive doses, and the presence of body conditions which contraindicate the use of x-rays all eliminate the possibility of the use of isotopes; lymphogranuloma, bone marrow tumors, and bone metastases are resistant to radiophosphorus therapy. In cases of polycythemia, a 4- to 6-mc initial dose of $P^{32}$-phosphate is given, followed by 2 mc at 2- to 3-day intervals, giving a total dose of 10 to 12; this is followed by a slightly larger supplementary dose in 6 to 10 weeks and again in 3 to 4 months; changes are expected 20 to 30 days after the injections. In cases of chronic leukemias, 10 to 20 mc are given in 2- to 4-mc doses at 2- to 3-day intervals; this may be repeated in 9 to 12 weeks, depending on the sensitivity of the case; 10 to 30 mc are given in cases of lymphosarcoma. In cases of hyperthyroidism, $I^{131}$ is given in total doses of 1 to 6 mc, graduated over 4-day periods; amelioration is expected within 3 to 6 weeks. The author discusses the use of locally applied radioisotopes of Zn, Au, Co, and Mn.

2920 Radioactive Phosphorus in the Treatment of Polycythemia. William M. Cooper. Hahnemannian Monthly 85, 3-6(1950) Jan.-Mar.

The results of the treatment of 17 cases of polycythemia vera with $P^{32}$ are presented. Each patient was given 5.3-mc initial dose of the isotope by mouth (or about 4.0-mc effective oral dose); 3 weeks later each received a 3.0-mc effective dose and returned in 4 more weeks to have hematocrit and other tests run. The average total dose administered was 6 to 8 mc given intravenously, or 8 to 12 mc orally; the average time to produce the desired effects was about 16 weeks; in 5 patients phlebotomy was carried out to control immediate symptoms. The clinical improvements were striking: spleens decreased, hemorrhagic symptoms ceased, patients were mentally more alert. Because of its mode of action, ease of handling, and the excellent results obtained, the author concludes that radiophosphorus is the agent of choice in the treatment of this disease.

2921 Radiosensitization of Epitheliomas of the Thyroid by Means of Aminothiazol. M. Dargent, J. Papillon, and P. Guinet. J. Radiol. Electrol. 30, 15-21(1949) (in French).

A review of previous discussions on radiosensitivity, methods and results in working on the problem, and a discussion of the rationale of the use of various substances in-

cluding $I^{131}$ in increasing radiosensitivity are presented. Case histories of 6 cases of loss of radiosensitivity after some type of therapy including x-ray, radium, and surgical are presented in detail; 4 of the cases reported showed recovery of sensitivity when aminothiazol was administered with radiation delivered at 200 kv through 1 mm Cu in total doses of 500 to 6,000 r, depending on the case. One instance of reaction to the aminothiazol is reported. 44 references.

2922 Radiotherapy of Acne. J. Watrin. J. Radiol. Electrol. 30, 659(1949)(in French).

The treatment of acne with x-ray doses of 80 kv, 2 ma with an anode distance of 20 cm, giving a maximum of 4 to 6 courses given every 2 weeks, using 4 ports, is compared with other therapy in different clinical conditions, including keloids, rosaceous acne, and blackheads. The author concludes that improvement of the condition usually depends on the use of more than just radiation, but this is the method of choice in some cases.

2923 Radiotherapy in Epicondylitis. J. Bernard and G. Duteil. J. Radiol. Electrol. 29, 307-8(1948)(in French).

The use of radiotherapy to relieve the symptoms of epicondylitis and manifestations of the disorder are discussed. Radiation is delivered at 200 kv through a 0.5-mm Cu and 2-mm Al filter, at 30 cm, through a small local port in 200 r doses, three times a week, giving a 2,000 r total dose; one case of erythema was noted, but the irradiation was followed by symptomological relief in nine cases over 2- to 6-month periods and relief, except for some movements, in five other cases. The authors conclude that this simple technique of novacainization and radiotherapy is a possible method of relieving the spontaneous pangs associated with epicondylitis.

2924 Radium Therapy of Chronic Tonsillitis. V. S. Stepanova. Vestnik. Otol. i.t.d. 1, 58-62(1949)(in Russian).

The results of the treatment of 56 cases of chronic tonsillitis by radium therapy are presented. Doses of 320 mg/hr were delivered to each side of the mandible by a moulage containing two 80-mg radium-mesothorium applicators. X-irradiation at 3 cm for a total dose of 1,000 to 2,000 r was also employed. A total of 32 patients was cured, while 17 showed no improvement.

2925 Report of Society Transactions of the New York Academy of Medicine, Section of Ophthalmology, held on February 16, 1948. Arch. Ophthalmol. 43, 588 (1950) Mar.

Among the papers presented was Beta Radiation in Ophthalmology, by F. H. McKee. A number of conditions treated by beta-radiation therapy are listed, along with the results achieved; among those mentioned are tuberculosis of the anterior ocular segment, acne rosacea, distichia, herpes, trachoma, and interstitial keratitis. The three most common types of beta-ray applicators in use are the Burnam radon bulb, the radium plaque, and the radium-D applicator. The dose can be limited to 1 or 2 mm of tissue, thus drastically reducing radiation damage of normal tissues and producing excellent results in many ocular diseases. New types of applicators are available which simplify treatment.



2926 Report of the Thirty-first Meeting of the Southwest German Throat-Nose-and-Ear Doctors in Mainz on the 24-25 of September, 1949. Zentr. Hals-Nasen Ohrenheilkunde 39, 195-6(1949) Nov. (in German).

Among the papers presented were: Radium dosages in the treatment of vocal cord carcinoma, Grad; and Radium as a foreign body, Mende. In the first paper a method for irradiating the vocal cord with radium applicators after first opening the thyroid cartilage is presented; small, protracted, and fractionated dosages are advocated in order to avoid necrosis and other impairment of vocal-cord function. Applicators of the 5-mg size are used and are allowed to remain in place 240 to 300 hr. Good results have been obtained without accompanying perichondritis. In the second paper a 4-mg radium needle had been inserted into a tonsil and was subsequently swallowed; after 7 days a laparotomy was performed, and the needle was found to be lodged in the appendix; a similar case is also cited.

2927 Results of Teleroentgen Therapy in Inoperable Breast Cancer. M. Dargent and J. Papillon. J. Radiol. Electrol. 29, 318-21(1948)(in French).

In 28 cases of breast cancer, radiation was delivered at 200 kv, through a 0.5 mm Cu filter, at 140 cm, target distance for a 25 to 75 r/dose, through 2 anterior and 2 posterior ports, giving a total of 250 to 750 r/series which was repeated in 3 to 6 months as was necessary. The type of malignancies are considered separately; comments on the hematology and mechanism of irradiation action are discussed. The results are 12 excellent reactions: tumor regression and amelioration of the general condition; 11 good results: stasis or improvement; and 5 poor results in the most resistant type which showed no improvement.

2928 Roentgentherapy of Chronic Pancreatitis. A. Streda. J. Radiol. Electrol. 29, 257-60(1948)(in French).

After a brief review of the diagnostics of pancreatic disorders, 3 cases of inflammatory hypertrophy are reported which responded favorably to roentgen therapy. Radiation was delivered through 2 dorsal and 2 ventral ports totaling 150 r/day for each, and a few skin doses of 2,000 r were delivered in the pancreatic region.

2929 Roentgentherapy of Chronic Tonsillitis. Ya. B. Kaplan and A. V. Kantin. Vestnik. Otol. i.t.d. 1, 62-7(1949)(in Russian).

The results of the x-ray treatment of 102 patients with chronic tonsillitis are presented. The radiations were delivered by a 60-kv machine, through a filtration of 3 mm Al and 0.5 mm Cu, at a target distance of 30 cm; the first dose was 187.5 r delivered to one side of the neck, followed by a similar dose the succeeding day to the other side of the neck and continued for a period of 8 to 10 days, or until each field received 750 r. Eighty of the patients received one course, and 22 received a second course; in 90 of the patients the swelling was reduced, and the results in general were very good. It is concluded that in most cases of tonsillitis, and especially when operation is contraindicated, this method of treatment is very satisfactory, painless, gives quick results, and leaves the tissue intact for further use. A further study is in progress.

2930 Roentgen Therapy of Prostatic Hypertrophy. Gaston Daniel. J. Radiol. Electrol. 29, 520-21(1948)(in French).

The use of radiation for prostatic hypertrophy in conjunction with cystostomy is discussed in terms of contraindications and other symptoms which may disappear as a result of roentgen therapy. After considering various techniques, the author concludes that a total dose of 4,200 r delivered through pubic and sacral ports plus 1,000 to 1,500 through a perineal port over a 15-day period is satisfactory; the radiation is delivered as follows: 350 r/dose delivered at 160 to 200 kv, 1-mm Cu and 2-mm Al filter, at 40 cm, each day for 12 days, alternating the pubic and sacral ports; 500 r/dose in 2 to 3 doses for the remaining 3 days delivered at 110 kv through 5-mm Al filter at a distance of 12 cm.

2931 The Roentgen Treatment of Cutaneous Carcinoma Involving Cartilage. Leo M. Levi. Am. J. Roentgenol. Radium Therapy 61, 380-6(1949) Mar.

Complete clinical reports of six cases of cutaneous carcinoma involving cartilage are given. Two patients received radiation delivered at 200 kv through 1-mm Cu and 2-mm Al filters at focal distances of 40 and 50 cm for a total of 5,000 r; the others received radiation delivered at 105 kv, 30-cm focal distance, in 3 doses of 1,500 r (air)/dose through filters of 1 to 4 mm Al. An erythema developed in each case for variable periods of time, but no perichondritis was noted. All cases were cured so that the authors conclude that this method is preferable to surgery unless complications are present.

2932 Semi-contact Radiotherapy (Semi-Short-Distance Therapy). Techniques, Indications and Results. Gaston Daniel. J. Radiol. Electrol. 30, 675-8(1949) (in French).

The author discusses in detail the use of semicontact radiotherapy. The amount of diffuse aberrant rays which are not absorbed under usual conditions is large and is shown to vary with the voltage. Various skin and other superficial malignancies and other conditions were treated with voltages of from 50 to 180 kv with various filters. Radiation at a 6-cm focal distance is used for skin cancer. Twelve-centimeter focal distances are used for small local tumors, with radiation delivered at 85 kv filtered by 2.5 mm Al, or with radiation delivered at 110 kv, filtered by 5 mm Al for such conditions as chronic rhinitis, adenoiditis, otitis, suppuration with or without polyps, otosclerosis, sinusitis, chronic metastases of breast tissue, chronic skin infections, arthritis, periarthritis, others of the same character, tracheobronchial adenopathy, chronic tubercular or gonoccocal prostatitis and epididymitis, thyroid and parathyroid disorders, and tumors of the pharyngeal region. A 16-cm distance with radiation delivered at 110 kv through a filter of 4 mm Al through a cylinder 2 cm in diameter and 12 cm long is used for insertions in treatment of neoplasms of the uterine canal. The author concludes that the optimum treatment for chronic superficial inflammations is 110 kv delivered through 5 mm Al in a series which depends on the disorder, for suppuration drainage, is 85 kv through 2.5 mm Al in 2 series of 800 r each, and for surface-limited cutaneous neoplasms, is 70 to 85 kv through 0.5 to 2.5 mm Al. For irradiation to be delivered by an inserted tube or cone in the larynx



or vagina, approximately 110 kv through 5 mm Al should be given, with the total dosage dependent on the case.

2933 A Simple Method of Determining the Tissue Dose to the Skin and to the Lesion. Arthur W. Erskine and Geraldine F. Unangst. X-Ray Technician 21, 274-8 (1950) Mar.

This article discusses practical means of determining the dosage received by the skin and that received by diseased tissue (tumors, etc.) upon irradiation by x-rays. The authors lean heavily on the data gathered in Physical Foundations of Radiology (Glasser, et al., New York, Paul B. Hoeber, Inc., 1944) which in their opinion can be confidently relied upon. From these tables they show how to construct simplified "working tables" from which dosimetry calculations can be made with a minimum of labor. A method of interpolation for these tables is also described.

2934 Some Considerations in the Treatment of Hemangioma in Infants and Young Children. Eugene P. Pendergrass, James C. Katterjohn, and James B. Butchart. Am. J. Roentgenol. Radium Therapy 60, 182-92(1948) Aug.

The general therapy of hemangioma is extensively discussed in terms of its histology, methods of treatment such as surgical excision, x-ray, radium, grenz ray, $CO_2$ snow, scelerosing injections, tattooing, ultraviolet radiation under pressure, electrocoagulation, cosmetic disguise, preferred course of treatment, improvement recordings and comparisons, type of lesions, and precautions used in roentgen therapy. Contact doses at 1.9 to 5.0 cm were delivered by machines of 44 to 135 kv through filters up to 5 mm Al in all cases except those with bulky lesions which were treated with intermediate voltages of 75 to 135 kv through a 1- to 3-mm Al, or 0- to 0.2-mm Ni filter; doses of 200 to 400 r for each lesion in 3 to 7 treatments at 4- to 6-week intervals, giving a total of 1,250 to 1,750 r until the skin discoloration disappears, were given. This was followed by random implantations of 0.1 to 0.5 mc placed through small multiple punctures in the deeply situated hemangioma, giving a total of 1,000 $\gamma$ delivered to the lesion. The authors conclude that this is the preferred method of treatment.

2935 Some Depth Dose Studies of Roentgen Rays for Energy Levels from 20 to 100 Million Electron Volts. E. E. Charlton and H. E. Breed. Am. J. Roentgenol. Radium Therapy 60, 158-74(1948) Aug.

Graduated doses of roentgen rays having energies up to 100 Mev, and produced by an electron accelerator with a toroidal tube of Pyrex glass having an inherent filter of $\frac{1}{8}$ in. of borosilicate, were delivered to a tungsten target. Densitometric readings with errors less than 1% were obtained on Eastman type M film on areas of 0.079 $cm^2$. The method of calibrating ionization with density is described. Isodose curves and charts for 50, 70, and 100 Mev are made by densitometering the axial phantom films and converting density readings to relative ionizations; the relative ionization variation with the depth of dose is plotted for 20 to 100 Mev. The results of some tests on obtaining a desired dose for a given depth are graphed; intensity is plotted against the angle in the cone of the beam; the distance of the target-phantom and the variability of maximum ionization

are tabulated and calculated. Operational expressions are derived for the radiant flux incident per unit area at any depth. The variation of per cent ionization with depth for 20 to 50 Mev with filters of Pb, Cu, Al, and without filter is graphed and discussed. The authors conclude that depth-dose data show a changing energy-distribution pattern with large variations in roentgen-ray voltages which has a characteristic optimum voltage to obtain the maximum ionization intensity at a desired depth. Applications to therapy are suggested.

2936 Some Results of Contact Therapy at the Anti-Cancer Center at Nantes. Gauducheau, Lainé, Tardiveau, and Sorin. J. Radiol. Electrol. 29, 552-5(1948)(in French).

Radiation delivered at 50 kv through 0.2 mm Al at a distance of 2 cm was used on 14 cases of superficial skin disorders, including epitheliomas, papillomas, and warts. Each type is considered separately in terms of the variation in technique used, such as slightly larger distances, other filters of up to 2.7 mm Al, and total doses of 300 to 7,800 r. The results are considered good except for one case of radioepidermititis after a single 7,800 r dose.

2937 A Study of Survivals in Hodgkin's Disease Treated Radiologically. M. Vera Peters. Am. J. Roentgenol. Radium Therapy 63, 299-311(1950) Mar.

The results of the radiological treatment of 257 cases of Hodgkin's disease are presented. At the present time the moderately and extensively involved lymphatic regions are irradiated, using a 400-kv apparatus with a 0.6-mm Sn filter at a target distance of 100 cm; the total dosage to each region is 1,800 to 5,000 r, depending on the extent of involvement and the resistance to irradiation. The uninvolved peripheral regions, when included in the therapy, each receive a total of 400 to 800 r from a 200-kv machine with a 0.2-mm Sn filter at a target distance of 50 cm; mediastinal nodes and deep lumbar nodes are irradiated through 2 anterior and 2 posterior portals with 400 r to each portal. Single recurrences receive 200-kv therapy, 400-kv irradiation, or teleradium. The over-all 5-year survival rate of 51% and the 10-year survival rate of 35% observed are considerably better, the author concludes, than any other survival rate reported in the literature to date. The extent of involvement on the institution of treatment and the presence of constitutional symptoms are considered the two most important factors affecting the prognosis. Age and sex also affect the outcome; young patients respond more favorably to therapy, and female patients exhibit a more chronic form of the disease. 14 references.

2938 Techniques for Application of the Betatron to Medical Therapy. G. D. Adams, G. M. Almy, S. M. Dancoff, A. O. Hanson, D. W. Kerst, H. W. Koch, E. F. Lanzl, L. H. Lanzl, J. S. Laughlin, H. Quastler, D. E. Riesen, C. S. Robinson, and L. S. Skaggs. Am. J. Roentgenol. Radium Therapy 60, 153-7(1948) Aug.

The 22-Mev betatron delivers a beam from a focal spot less than 0.2 mm in diameter and requires 1.6 cm of lead for reduction to half intensity; the beam reaches half intensity at 4 to 5 deg from the central ray and generates many high-energy primary electrons in directions other than that of the beam itself. Dosimetry calculation in absolute roentgens is impractical, but tissue doses can be measured and calibrated in the usual way; depth dose is expressed in terms of a percentage of the surface dose, which is in this case more difficult to measure, since the maximum tissue dose occurs about 4 cm below the surface. A lead collimeter is described which transmits 6% of the incident intensity at 20 Mev. Compensating filters of carbon, lead, copper, and graphite are compared for their ability to improve the character of the beam by selective absorption, reducing low-energy content, and by shaping, giving a desired intensity distribution; contours of dose distributions are graphed. Monitoring of the irradiation is accomplished, preferably by a foil which can be calibrated for each energy with an error of less than 1%.

2939 Therapy Technique. Hermann Holthusen, B. Lindemann, and A. Vonessen. In FIAT Review of German Science, 1939-1946: Radiology, Diagnostic and Therapeutic, pp. 210-28. Office of Military Government for Germany, Field Information Agencies Technical, 1947 (in German).

This article is a summary of and guide to recent German literature about the various techniques of radiation therapy. Dosimetry is discussed in detail for irradiation with x-rays, $\beta$ and $\gamma$ rays, and neutrons. Special techniques mentioned are irradiation with rotating and oscillating beams and the irradiation of very small volumes. 61 references.

2940 Treatment of Metastases from Cancer of the Breast. Jacob R. Freid and Henry Goldberg. Am. J. Roentgenol. Radium Therapy 63, 312-26(1950) Mar.

The results of the treatment of metastatic cancer cases with radiotherapy are presented; the details of 10 cases treated with x-rays and 1 case treated by surgery are included. Localized recurrences were intensively irradiated with a total of 3,000 to 5,000 r in divided doses, with medium- or low-voltage x-rays. Large, bulky recurrences were irradiated through several fields in order to cross-fire the lesions, and usually 2,500 to 3,000 r/field was delivered. It is noted that radiotherapy is usually effective for the eradication or palliation of the local disease.

2941 Treatment of Prostate Cancer by Endoscopic Route, with Associated Radiotherapy. P. Dufour and R. Denis. J. Radiol. Electrol. 29, 317-18(1948)(in French).

Irradiation of 2,000 r through the perineal port and 1,000 r through the transvesical port over a 12-day period, delivered at 200 kv, 1.5-mm Cu and 2-mm Al filter, in 200 r doses is considered an optimum prophylactic dose which will eliminate as much as possible the danger of metastases and improve the survival rate and time.

2942 The Use of Roentgen Ray in Body Measurements: A Mathematical Method, Preliminary Report. Louis O. J. Manganiello. Am. J. Roentgenol. Radium Therapy 60, 664-7(1948) Nov.

A simple method of measurement of the distance between two points in a three-dimensional space, knowing the film and two tube positions, is developed and its accuracy proved. This may be of use in determining positions of foreign bodies or tissue measurements.

2943 Whole Body Teleroentgen Therapy in the Acute Form of Malta Fever. André Denier. J. Radiol. Electrol. 29, 662-3(1948)(in French).

Whole-body radiation delivered by a 300-kv machine at a focal distance of 240 cm, giving 40 to 50 r/dose or in partial radiation delivered at 200 kv in two doses is used. Modification of venous blood pH, changes in cellular permeability, and blood sedimentation rate (which returns to normal after 15 to 20 days) are noted. If remission does not occur quickly after the first dose, a second or third may be given. The author concludes that on the basis of 33 observations, the results are in general very good after the first dose and that rarely more doses need be given.

2944 The Acute Distribution of Intravenously Administered Lead Acetate in Normal and BAL-Treated Rabbits. Michael Ginsburg and Miles Weatherall. Brit. J. Pharmacol. 3, 223-30(1948) Sept.

In order to test the actions of BAL in lead poisoning and to discover its effects on lead distribution in the body, young rabbits received intravenous doses of 2.07 mg of lead/kg body weight as the acetate containing 100 to 300 $\mu$c of $Pb^{212}$; therafter they received water, but no food, and were sacrificed at 1, 6 or 24 hr. Blood and urine were collected; various organs and tissue samples were dissected, washed, dried, weighed, digested with nitric acid, and neutralized, and the lead was precipitated as the sulfide. Data and results are given on 14 animals which received lead, 8 of which received intramuscular doses of 50 mg BAL/kg at one dose; 6 of these received additional doses of 12.5 mg/kg at varying intervals. A discussion of the results concerning the high concentration volumes and the changes in these concentrations after BAL administration is given.

2945 Delayed Subcutaneous Beryllium Granuloma. Edward A. Shorten and Horace K. Giffen. Arch. Surg. 60, 783-6(1950) Apr.

A case of delayed subcutaneous beryllium granuloma developing about three years after the patient had been accidentally cut by a fluorescent tube is presented. Magnesium tungstate was found in the part of the lesion excised; the absence of the component zinc beryllium silicate in the lesion indicates to the author that it disappeared in some manner after implantation. It is concluded that a knowledge of the lesion caused by fluorescent lamps is important and that the only way to reasonably assure permanent cure is to make a wide excision of all cuts caused by beryllium-containing materials.

2946 Effects of BAL and BAL Glucoside in Acute Lead Acetate Poisoning. M. Weatherall. Brit. J. Pharmacol. 3, 137-45(1948) June.

Red cell fragility tests, reticulocyte and red cell counts, hematocrit and hemoglobin determinations, and urine and fecal coproporphyrin determinations were made on 136 rabbits that received lead acetate by stomach tube, 43 of which also received BAL, BAL glucoside, or glucose by intramuscular injections. Extensive reports of the results are given and discussed. The author concludes that BAL and its glucoside prevented the decreases in red cell fragility due to lead acetate, mixtures of BAL and plasma or plasma from BAL-treated animals protected erythrocytes more than BAL or plasma alone, BAL and its glucoside decreased the anemia due to lead acetate and increased coproporphyrinuria, and only the BAL glucoside reduced the mortality rate.

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2947 The Effect of BAL on the Urinary Copper Excretion of Sheep. James Stewart and Hamish Robertson. Biochem. J. 43, xxii-xxiii(1948) No. 3.

A preliminary study on nonpregnant sheep was done to determine whether BAL reduced the blood or liver reserve Cu; 5% oil solutions were injected intramuscularly in doses of up to 20 ml, and 24-hr urinary Cu determinations were done over periods of 60 days. An increase of urinary Cu of 2 to 15 times the normal, a liver Cu decrease of 7 mg/60 days for a 20-ml total dose, and no increase in fecal Cu were noted. The authors concluded that the increase in Cu excreation is due to increased total urine output and excretion of Cu bound to the BAL.

2948 The Effect of Environmental Temperature on the Toxicity of BAL. F. F. McDonald. Brit. J. Pharmocal. 3, 116-17(1948) June.

In order to determine the effect of temperature on the toxicity of BAL, 460 rats were given intramuscular injections of 140 mg/kg of BAL, and the survival times were noted for 72 hr at 17 different temperature steps in the range 39 to 84° F. The results are graphed, tabulated, and discussed in terms of per cent mortality and $LD_{50}$; the authors conclude that toxicity varies with temperature fitting the parabola: $LD_{50} = 152 - 0.07(t-63)^2$, where t is the temperature in °F.

2949 Experimental Production of Malignant Tumors by Beryllium. J. M. Barnes. Lancet 258, 463(1950) Mar. (Letter to the editor).

A summary of the results of two sets of experiments on beryllium is presented. In the first series a total of 28 rabbits survived a course of intravenous injections of zinc beryllium silicate and beryllium silicate; of these, 7 have developed bone sarcoma and 5 remain alive 2.5 years after the injections. The tumors have all the histological characteristics of bone sarcoma seen in man and resemble tumors produced in rabbit bones by radium. In March of 1949 a washed suspension of finely divided beryllium metal in water was administered to a group of 24 young rabbits as the first of a series of intravenous injections, each animal receiving 40 mg of the metal; within 7 days, 9 rabbits died with acute liver necrosis, and within the next month 10 more followed. Of the remaining 5 rabbits, 2 have died from pulmonary infections while 2 have developed characteristic bone sarcomata. The author concludes that there seems to be little doubt that beryllium is capable of producing neoplasms in the rabbit.

2950 Experimental Production of Malignant Tumours by Beryllium. Peter Nash. Lancet 258, 519(1950) Mar. 18 (Letter to the editor).

A total of 28 rabbits were injected intravenously and repeatedly with 1% suspensions of beryllium oxide and zinc beryllium silicate. After an interval of 9 to 19 months, 5 of these rabbits developed typical bone sarcomas; the exact dosage necessary to cause this disease is not known, but one of the animals received 200 mg of zinc beryllium silicate over a period of 2 weeks. The author concludes that since rabbits are the only animals in which the bone sarco-

mas have been experimentally produced by beryllium, it may be premature to suggest that they may also arise in exposed industrial workers.

2951 Metabolism of Radioactive Strontium in the Rabbit. Margaret Tutt and Janet Vaughan. Biochem. J. 44, xxxv(1949) No. 4.

Normal rabbits with an average calcium intake of 3 to 5 g in a 9-day period received intravenous injections of $Sr^{89}$ and $Sr^{90}$ as the chloride in a NaCl solution. Fecal, urinary, and carcass Sr determinations were made which showed that most of the Sr retained was found in bone and that the retention varied with age from 10 to 55%. Suckling mothers transferred about 20% to the litters, but pregnant mothers transferred only 1 to 3%.

2952 On Beryllium Injuries. Hanskarl Niemöller. Deut. Med. Wochschr. 20, 652(1949) Mar. (Brief report, in German).

After a brief summary of cases of beryllium poisoning as first observed in Germany in the twenties and thirties, the author describes 34 such cases observed recently by him in the course of a quarterly investigation of workers handling beryllium. In all cases beryllium hydroxide dust and the dust of the ground metal are considered responsible for the injuries observed. A detailed description is given of the symptoms observed in the respiratory tracts of the persons affected.

2953 Osteosarcoma Induced by Beryllium Oxide. Frank R. Dutra and Edward J. Largent. Am. J. Path. 26, 197-209(1950) Mar.

Malignant bone tumors (osteogenic sarcomas) have developed in 6 of 9 rabbits within the period of 16 months after the beginning of serial intravenous injections (0.013 to 0.116 g/$\mu$g body weight/injection) of beryllium oxide. The injections were given three times a week and were continued for from 6 to 8 weeks for a total of 17 to 26 injections. The primary tumors, when subjected to chemical analysis, have been found to contain little beryllium. Tumor fragments from one animal were capable of growth in the anterior chamber of the eyes of guinea pigs. Thus the continued growth of the osteogenic sarcomas, once established, appears to be independent of the presence of beryllium. (auth)

2954 Reactions with Heavy Metals and Their Bearing on Poisoning and Antiodote Action. James L. A. Webb, Iqbal Singh Bhatia, Alsoph H. Corwin, and Alvin G. Sharp. J. Am. Chem. Soc. 72, 91-5(1950) Jan.

Sulfhydryl compounds are essential for the growth of many, and probably all, cells. Recently a large group of enzymes has been shown to contain -SH groups essential for enzymatic activity. This activity is inhibited by mercury and arsenic compounds and is restored by glutathione. The poisoning thus results from metallic combination with essential sulfhydryl groups. Detoxicant action is a preliminary combination of a substance with the metallic poison in a compound so firm that the metal is not available for reaction with essential sulfhydryls. Antidote action is observed after combination has taken place with the essential sulfhydryls, but when the affinity of the antidote for the metal is greater than that of the essential sulfhydryls displacement takes place. Dithizone, $C_6H_5N{=}NC(SH){=}NNHC_6H_5$, will react with



the mercury in mercurials of the types $HgX_2$, $R'HgX$, $R'_2Hg$, $R'HgSR''$, and $(R'S)_2Hg$. Dithizone will cleave C-Hg bonds to form S-Hg bonds. Alkyl and aryl mercuric dithizonates tested could be cleaved further to yield mercuric bisdithizonate. Mercury can exchange between different sulfur compounds. Mercuric bis-dithizonate and certain other mercurial dithizonates are reversibly sensitive to light. (auth)

2955 Studies of the Inhibition of Acidic Phosphatases by Fluorides. I. The Influence of NaF on the Kinematics of the Reaction. J. Courtois and C. Anagnostopoulos. Bull. soc. chim. biol. 31, 1494-1503(1949)(in French).

After a discussion of possible mechanisms of fluoride inhibition, the results of tests to determine the influence of total fluoride, fluoride concentration, phosphatase concentration, orthophosphates liberated during hydrolysis, and substrate type and concentration on inhibition are tabulated and discussed. The authors conclude that these tests tend to show that the fluoride forms a strongly dissociable compound with the enzyme. 13 references.

2956 Studies on the Inhibition of Acid Phosphatases by Fluorides. II. Inhibition and Reactivation Under Diverse Conditions. C. Anagnostopoulos and J. Courtois. Bull. soc. chim. biol. 31, 1504-9(1949) (in French).

Results of tests to determine the action of Ca, Mn, and Zn fluorides in solution on inhibition of phosphatases are given, followed by a description of the technique and experimental results in reactivation of the phosphatases by dialysis, salt precipitation, and adsorption in solution. The results indicate a possible substrate combination rather than an enzyme-fluoride combination, since reactivation is more rapid when the substrate is removed. The authors conclude that saturated solutions of Ca, Mn, and Zn fluorides have the same degree of action as corresponding amounts of NaF, but different degrees of action with different phosphatases; some phosphatases may be reactivated by dialysis, ammonium sulfate precipitation, and Al adsorption; the F does not precipitate a metallic ion which is indispensible for phosphatase activity, and its combination with the enzyme itself is easily dissociable.

2957 Toxicity of 2:3-Dimercaptopropanol (BAL) in Young Rats. J. D. P. Graham. Biochem. J. 43, xxxii(1948) No. 5.

Ten sets of white rats were divided into six groups; these were fed ad lib, and weighed daily; three groups received 10 ml/kg arachis oil/day, and the other three received 10 mg BAL in 10 ml arachis oil/kg/day; one experimental and one control group each were sacrificed at 14, 28 and 56 days. Similar experiments on three other groups, receiving 50 mg BAL/kg/day for 14 days, were run parallel to this series. The results showed no significant increase in appetite, weight of thyroid, thymus, liver, kidney, spleen, lungs, gonads, dried femur, heart, and gut and no change in the normal growth curve. In the parallel experiments the thymus was 4% lighter with some pyknonecrosis, and the thyroid was slightly heavier and showed histological evidence of a microfollicular hyperplasia. The author concludes that BAL in doses up to 50 mg/kg is not very toxic to growing rats.

2958 The Toxicology and Pharmacology of Methyl Fluoroacetate (MFA) in Animals, with Some Notes on Experimental Therapy. G. L. Foss. Brit. J. Pharmacol. 3, 118-27(1948) June.

The toxicity of methyl fluoroacetate was determined by oral, respiratory, and intravenous administration for mice, rats, guinea pigs, rabbits, cats, dogs, goats, monkeys, and a horse and was compared in terms of behavior and clinical symptoms to similar experiments on nicotine, strychnine, and metrazol toxicity. Blood sugar, nonprotein nitrogen, K, Ca, inorganic phosphate, and hemoglobin determinations were made; blood pressure, respiratory, reflex, electrical convulsive threshold, and $LD_{50}$ observations were made; the effects of various therapeutic measures such as anaesthetics, oxygen, and tubocurarine chloride were tested. The author concludes that this is a convulsant poison which depresses the central respiratory system and is toxic in similar doses by inhalation, injection, and oral administration, but not by skin application; it is not readily detected by taste or smell and is destroyed with difficulty.

2959 Counting $Fe^{55}$ in the Nucleometer. John H. Rediske. AECU-732, nd. 2p.

This is not an abstract; the document is reproduced below in its entirety.

$Fe^{55}$, because of the high specific activities that can be obtained, is ideally suited for many biological experiments involving iron. However, because of the relative inefficiency of most counting devices for the weak x-rays and conversion electrons, much of this advantage is lost. The Nucleometer has been found to be an exception. As would be expected, it is very insensitive to the x-rays, but counts the conversion electrons with a high degree of efficiency.

A great deal of care is necessary in the preparation of the sample because these conversion electrons are of low energy. It has been found that a 2 $mg/cm^2$ Al absorber will reduce a sample to background.

The plant material on which analyses are to be made is wet ashed by the sulfuric acid, perchloric acid method described by Piper (Soil and Plant Analysis. New York. Interscience Publishers, 1944). Usually the whole sample is ashed and made up to volume, thus eliminating the grinding and weighing of a small sample on the analytical balance. A suitable aliquot is then placed in a test tube. The procedure for the formation of a colored ferric thiocyanate complex is then followed, according to Sandell (Colorimetric Determination of Traces of Metals. New York. Interscience Publishers, 1944) as for the colorimetric determination.

Usually a 10-ml aliquot is used, and 1 ml of 20% KSCN is added. This mixture is then shaken vigorously with 1 ml of iso-amyl alcohol and allowed to separate into two layers. The upper layer has now taken up the ferric thiocyanate complex, and a suitable aliquot may be pipetted off, usually 0.2 ml, and placed in a flamed stainless-steel counting disk. This aliquot is immediately evaporated to dryness under a heat lamp. The ferric thiocyanate complex is very unstable and decomposes when heat is applied. This results in the volatilization of some of the products, leaving iron as a residue. Thus there is a minimum of material conducting self-absorption.

The disk with the sample is now sprayed, using an atomizer, with a solution of Aquadag of a concentration of 0.0044 g of concentrated Aquadag per milliliter. The disk



is usually sprayed while hot so the drops will dry immediately and in place. If the disk is sprayed cold and then heated, the ammonia responsible for the suspension of the colloidal graphite will evaporate. This causes the particles to coalesce and precipitate in clumps, giving an appreciable absorption of the conversion electrons.

The exact concentration of Aquadag appears not to be too critical so long as the layer of graphite is thin enough to minimize absorption, yet thick enough to be conductive.

This coating of Aquadag has been found necessary, especially on samples of high activity, to prevent the building up of a positive charge on the counting disk because of a nonconductive sample. This lowers the effective voltage within the tube, giving a decreased counting rate.

The foregoing procedure, heating and spraying, is usually repeated at least once. The disk is now ready for counting.

It has been found that under optimum conditions variations between duplicates can be reduced to 5%. This is in contrast to errors as high as 20% when using precipitation methods in the preparation of the sample. These large errors are evidently caused by variations in self-absorption induced by variations in thickness of the added material in the sample.

2960 The Effect of Temperature Upon the Uptake of Radioactive Phosphate by Human Erythrocytes in Vitro. Desmond R. H. Gourley and Chalmers L. Gemmill. AECU-733, nd. 15p.

Radioactive phosphorus ($P^{32}$) has been used to determine the uptake of phosphate ions by human blood cells in vitro. The per cent $P^{32}$ leaving the plasma in a given time is the same whether or not white cells are present. Thus, at least in the initial phase of the transfer, most of the $P^{32}$ leaving the plasma is taken up by the erythrocytes. The uptake of $P^{32}$ by the erythrocytes has the characteristics of a first-order reaction in the initial period. A study of the transfer process has been made at nine temperatures ranging from 15 to 40°C. Below 20 to 22°C, very little $P^{32}$ is taken up by the erythrocytes. However, the rate of $P^{32}$ uptake increases as the temperature rises, in accordance with the Arrhenius expression which relates the transfer velocity to temperature. The activation energy, $\mu$, calculated from the Arrhenius equation, is 16,700 calories. The marked difference in the transfer velocity over the relatively small absolute temperature range investigated indicates that the transfer process is chemical rather than physical in nature. 16 references. (auth)

2961 The Use of the Mass Spectrometer to Measure Deuterium in Body Fluids. A. K. Solomon, I. S. Edelman, and Sidney Soloway. AECU-736, nd. 34p.

The use of deuterium oxide ($D_2O$) for the measurement of total body water is based on the principle of isotopic dilution (Moore, Surg. Gynecol. Obstet. 86, 129(1948)). The technique involves a very large dilution of the isotopic compound, so that the precise accuracy with which the $D_2O$ is measured becomes the key factor in obtaining quantitative estimates of total body water. In order to obtain this accuracy, a mass spectrometer has been used; and this paper reports the procedure, calibration techniques, and the accuracy obtained. The inherent error in the method, the loss of deuterium by isotopic exchange, has been estimated as having a body equivalent of 0.5 to 2.0 of the body weight.

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2962 The Absence of α-Aminoadipic Acid in Cholera Vibrio. Emanuel Windsor. J. Biol. Chem. 182, 699-700(1950) Feb.

Using chromatographic methods of Stein and Moore to separate α-aminoadipic acid from other amino acids, including glutamic, experiments were performed to determine whether this acid is present in cholera Vibrio. $C^{14}$-labeled acid was tested as a control, giving a radioactive and ninhydrin peak at 40 to 42 ml; a filtered and dried hydrolysate of the organisms was dissolved and tested by photometric ninhydrin reaction; dicarboxylic acids separated from the hydrolysate and samples of the growth medium were also tested. The results were negative in all cases so that the authors conclude that α-aminoadipic acid is not accumulated by cholera Vibrio cultured on potato starch.

2963 The Absorption and Distribution of Radioactive Phosphorus in Two Maize Inbreds and Their Hybrid. Glenn S. Rabideau, W. Gordon Whaley, and Charles Heimsch. Am. J. Botany 37, 93-9(1950) Feb.

In the present study $P^{32}$ has been used as a tracer in order to investigate and correlate mineral accumulation by developing corn plants with structure and pattern of differentiation. Plants of two inbred lines of maize and their heterotic $F_1$ hybrid were grown individually in 1-gal crocks, and at weekly intervals some plants of each strain were exposed to a known volume of nutrient solution enriched with approximately 10 μc of $P^{32}$ for a period of about 8 hr under greenhouse conditions. At the conclusion of the absorption period, roots, nodes, internodes, leaves, and, when present, flowers and fruits were assayed for radioactivity. The hybrid strain, which had the largest root system, absorbed the largest amount of radioactivity. In all the strains tested, the highest concentration of $P^{32}$/unit area of internode samples was found in immature internodes; high radioactivity values also characterized immature ears and tassels and indicated a correlation between the isotopic distribution and meristematic activity; high radioactivity progressed in leaf growth from the tip to the mid-region to the base of the blade and further indicated meristematic activity and $P^{32}$ correlation. It is concluded that the hybrid advantage in $P^{32}$ absorption is associated with more rapid early development, earlier attainment of maturity, and differences in vascular organization.

2964 The Behavior of Cultures of the Tubercle Bacillus in the Presence of $S^{35}$-Labelled Sulfates. H. Noll, E. Sorkin, and H. Erlenmeyer. Helv. Chim. Acta 33, 23-4(1949)(in German).

In previous papers (Helv. Chim. Acta 32, 609, 1209, 1674 (1949)) the authors described the effect produced on cultures of the tubercle bacillus by the $S^{35}$-labeled 2-(p-Aminophenyl)-thiazol (APT). In the present work the influence of the $S^{35}O_4$ ions on the cultures was tested in various conditions. Surface cultures on Sauton's solutions with $S^{35}O_4$ ions assimilated in 19 days 1.29 and 1.16 γ S per milligram of dry bacteria. Surface and depth cultures in Sauton's solution in the presence of APT and $S^{35}O_4$ ions showed the inhibiting action of APT and the assimilation of S from the ions; after 30 days the S content was 0.581 γ/mg (surface) and 0.210 γ/mg (depth). A depth culture in Sauton's sulution containing APT, $S^{35}O_4$ ions, and 10% serum resisted the action of APT and assimilated, in 33 days, an amount of S equal to 1.13 γ/mg.

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2965 Biochemical Experiments with Radioactive 2:3-Dimercaptopropanol (BAL). S. D. Simpson and L. Young. Biochem. J. 44, xxv(1949) No. 3.

Radioactive BAL was prepared by allowing 2,3-dibromopropanol to react with sodium hydrosulfide which had been prepared from $H_2S^{35}$. The BAL-$S^{35}$ was extracted from the mixture and purified to 97.3% by fractional distillation at low pressure. The absorption, distribution, and excretion of $S^{35}$ by rats were studied following skin applications and intramuscular injections. The results are given and discussed.

2966 Changes in the Rate of Flow of Venous Blood in the Leg During Pregnancy, Measured with Radioactive Sodium. H. Payling Wright, S. B. Osborn, and D. G. Edmonds. Surg. Gynecol. Obstet. 90, 481-5 (1950) Apr.

Sixty-one normal pregnant women were studied monthly from their first appearance as maternity in-patients at 6 to 8 weeks of pregnancy until after delivery; the rates of flow of their venous blood were determined by means of $Na^{24}$. A small volume of sodium chloride solution containing 2 to 10 μc of $Na^{24}$/ml was injected under standard conditions of posture, rest, and temperature into one of the dorsal veins of the foot, and its passage through the femoral vein at the groin was recorded by a Geiger counter. A total of 12 other pregnant women had the hand-axilla venous flow times tested, and a small group of nonpregnant patients with ascites were measured for foot-groin times. The increase in the foot-groin time was fairly gradual and constant during pregnancy. The authors conclude that there is some evidence that the engagement of the fetal head might cause a secondary obstruction to blood flow. The slowing of the venous flow is confined to the leg regions; this slowing may be a factor in the onset of postoperative venous thrombosis.

2967 Citric Acid Formation from $C^{14}O_2$ by Aspergillus niger. S. M. Martin, P. W. Wilson, and R. H. Burris. Arch. Biochem. 26, 103-11(1950) Mar.

Isotopic studies with $C^{14}$ on the fixation of $CO_2$ by Aspergillus niger demonstrate that $CO_2$ is fixed by the mold and that the $CO_2$ carbon appears in the citric acid produced. Chemical degradation of the labeled citric acid shows that the labeled carbon appears exclusively in the carboxyl groups of the citric acid molecule and that the $C^{14}$ is almost equally distributed between the primary and secondary carboxyl groups. It is concluded that experiments designed to investigate the magnitude of the fixation reaction demonstrate that $CO_2$ can be an important intermediate in the formation of citric acid by Aspergillus niger. 16 references. (auth)

2968 The Distribution of Radioactive Iodine in Mice with and without Tumor 15091a after Injection of Radioactive Sodium Iodide. Charles D. Stevens, Mary Ann Meinken, Patricia M. Quinlin, and Paul H. Stewart. Cancer Research 10, 155-61(1950) Mar.

Measurements were made of the distribution of $I^{131}$ among the tissues of 206 mice killed either 45 min or 25 hr after injection of labeled sodium iodide in quantities varying from 0.0013 to 1.3 μg of iodine/g of mouse. Smaller quantities of $I^{131}$ were found in the thyroid glands of mice with implants of tumor 15091a than in the thyroids of control mice, although

the concentrations of $I^{131}$ in their blood were similar. Higher concentrations of $I^{131}$ were found in the spleens of tumor mice than in their blood on some occasions. Compared to the concentrations of $I^{131}$ in the sera, the livers and ear pinnae of mice contained lower concentrations of $I^{131}$, and their thymus glands contained higher concentrations than noted in the corresponding tissues in rats. Otherwise, the distribution of the injected iodide was similar in mice and rats. (auth)

2969 Distribution of Radioactivity in Rats and Man... After Intravenous Administration of Diethyl β-Radioiodoethyl Amine Hydrochloride and of Radioactive Sodium Iodide. Alexander M. Ruthenburg, Orrie M. Friedman, and Arnold M. Seligman. Cancer 3, 336-41(1950) Mar.

A comparison of the rate of disappearance of radioactivity from the blood and tissues of Wistar rats following the intravenous injection of $I^{131}NM$ (diethyl β-iodoethyl amine hydrochloride and $NaI^{131}$ indicated that most of the $I^{131}NM$ rapidly cyclized to the immonium ion with the loss of the iodide ion, but that a small fraction persisted in the blood, reached tissues intact, and penetrated the cells. The highest concentration of radioactivity due to $I^{131}NM$ was noted in thyroid and blood. Lower concentrations were present in lung, kidney, Bagg lymphosarcoma, and spleen. A similar distribution study in a patient with reticulum-cell sarcoma of the tonsil revealed a higher concentration of radioactivity in tumor, blood, and muscle following the injection of mustard than following sodium iodide; the tumor had the highest concentration of radioactivity following injection of both $I^{131}NM$ and $NaI^{131}$. Persistence of higher concentrations of $I^{131}NM$ than of $NaI^{131}$ in the blood of three patients was not observed. The distribution of radioactivity in the tissues of rats following injection of carrier-free radioactive iodide is described. 18 references. (auth)

2970 Distribution Studies in Mice Following Intravenous Injection of Methyl-Bis (β-iodoethyl) Amine Hydrochloride Prepared with Radioactive Iodine. Arnold M. Seligman, Orrie M. Friedman, and Alexander M. Rutenburg. Cancer 3, 342-7(1950) Mar.

Methyl-bis (β-radioiodoethyl) amine hydrochloride ($I_2^{131}NM$) was prepared from the chloro derivative by treatment of the base with radioactive sodium iodide ($I^{131}$) in acetone. A molecular equivalent was found to be about three times as toxic for mice as methyl-bis (β-chloroethyl) amine hydrochloride. A comparison of the rate of disappearance from blood and tissues and the appearance in the urine of radioactivity following intravenous injection of both $I_2^{131}NM$ and $NaI^{131}$ indicated that the mustard reacted very rapidly with the formation of radioactive-iodide ion, so that the rate of disappearance of radioactivity was similar to that of $NaI^{131}$. Within the limits of this technique, evidence that uncyclized mustard reached the tissues intact and penetrated cells was provided only for the lung. The highest concentration of radioactivity after the injection of $I_2^{131}NM$ or $NaI^{131}$ was noted in blood, lymph nodes, spleen, lung, and kidney. Lower concentrations of radioactivity were noted in the intestines and tumor. 19 references. (auth)

2971 Fixation of Formic Acid in Pyruvate by a Reaction not Utilizing Acetyl Phosphate. Harold J. Strecker, Harland G. Wood, and Lester O. Krampitz. J. Biol. Chem. 182, 525-40(1950) Feb.

Experiments were set up to test whether the high-energy phosphate bond of acetyl phosphate is used in the phosphoroclastic reaction. E. coli was grown in nonaerated glucose, aerated beef extract, and aerated peptone and harvested by centrifuge. Extracts which were prepared, using the method of Kalnitsky, did not fix $CO_2$ into pyruvate as tested with $NaHC^{14}O_3$. Nonisotopic pyruvate was prepared from pyruvic acid and $NaHCO_3$; acetyl chloride was prepared from acetyl sulfate and $NaC^{14}N$; acetyl phosphate was synthesized by the method of Lipmann and Tuttle from acetyl chloride; formic acid was prepared by reduction of $NaCHO_3$; $C^{13}H_3COOH$ was prepared from $C^{13}H_3I$ by the Grignard reaction; $CH_3C^{14}OCOOH$ was prepared by a method similar to Anker's. Details of the separation and methods of analysis are given. $C^{13}$ concentration was determined with a Nier mass spectrometer, and $C^{14}$ concentration was determined with a Geiger-Mueller counter. The results show that extracts from E. coli may be prepared which rapidly fix formate in the carboxyl group of pyruvate, but do not fix either synthetic acetyl phosphate or an acid anhydride formed from pyruvate. It is concluded that acetyl phosphate is not a direct intermediate in the fixation of formate from pyruvate so that there is no correlation between the phosphoroclastic reaction and formate production, since formate is rapidly fixed by enzyme preparations which produce little or no net breakdown of pyruvate. A discussion is given of the metabolic use of acetyl phosphate. 19 references.

2972 Histidine and Ascorbic Acid Treatment of Arteriosclerosis Obliterans; With Radioactive Isotope Estimations of Circulatory Effects. Morris T. Friedell, Edgar F. Drucker, and William J. Pickett. J. Am. Med. Assoc. 138, 1036-9(1948) Dec. 4.

Twenty-five patients with gangrenous or pregangrenous changes in one lower extremity were admitted with a diagnosis of arterioscelerosis obliterans as amputation candidates and were treated with histidine and ascorbic acid. Eleven of the 12 patients treated parenterally received 10 cc of $Na_2HPO_4$ containing 200 μc of $P^{32}$ in cubital intravenous injections. Probe counts on the soles of the feet were done and compared to similar studies on normals and studies on a few patients with radiosodium; the dose was repeated in 10 days and again compared. The results are tabulated and briefly discussed, but show wide variability. The authors conclude that in most cases there was an increased deposition of $P^{32}$ in the affected extremity and attributed this to the capillary stasis associated with arterioscelerosis. The conservative therapy tends to equalize the counts, and therefore it is concluded that the circulatory disturbance is removed. In cases where the counts are low, conservative methods are thought to be useless.

2973 Insecticides in Treated Foodstuffs. Chem. Age (London) 62, 295-6(1950) Feb. 25.

A special laboratory has been set up in the Dept. of Scientific and Industrial Research to study the "take-up" of fumigants and other insecticides by foodstuffs and insect tissues. The preparatory work for the study of methyl bromide, labeled with $Br^{82}$, is described.

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2974 Investigations on Porphyrin Formation in Congenital Porphyria with the Aid of $N^{15}$. C. H. Gray and A. Neuberger. Biochem. J. 44, xlv-xlvi(1949) No. 5.

In one case of congential porphyria, 12 g of glycine containing 31.65 at.% excess $N^{15}$ was fed in 12 doses over a 4-day period. Hemin stercobilin hydrochloride and fecal and urinary coproporphyrin and uroporphyrin $N^{15}$ determinations were made with a mass spectrometer over a period of 28 days. Liver-function tests over the first 12 days were performed, and the $N^{15}$ content of the hippuric acid excreted was determined. The authors conclude that uro- and coproporphyrin I and protoporphyrin IX are derived from glycine; most of the stercobilin is derived from something other than hemoglobin breakdown; the glycine required for conjugation with benzoic acid is obtained by tissue protein hydrolysis or from nitrogenous compounds with a low $N^{15}$ content.

2975 Investigations on Porphyrin Formation in Rabbits with the Aid of $N^{15}$. Helen M. Muir and A. Neuberger. Biochem. J. 43, lx(1948) No. 5.

Experiments on rabbits were made to determine whether the glycine-N enters all four pyrrole rings in porphyrin metabolism. The animals were fed 300 mg of glycine containing 30 at.% excess $N^{15}$/kg for 4 days and were sacrificed after 14 days. $N^{15}$ determinations on compounds crystallized from hemoglobins show no significant difference in content for acidic and nonacidic pyrrole rings; other experiments on rats to compare the $N^{15}$ content of hemin after feeding labeled ethanolamine and glycine show that ethanolamine is not a precursor of porphyrin structure.

2976 Isotopes as Tracers in Plants. R. H. Burris. Botan. Rev. 16, 150-80(1950) Mar.

A discussion is presented on the methods and modes of application of isotopic tracers and on the differences between stable and radioactive tracers. The applications of radioactive tracers in studies of ion absorption and exchange, transport of nutrients, photosynthesis, heterotrophic fixation of carbon dioxide, biological nitrogen fixation, metabolism of nitrogen in plants, metabolism of phosphorus in plants, phytopathology, and plant-growth regulator mechanisms are discussed and outlined; among the more important radioisotopes dealt with are $C^{11}$ and $C^{14}$, $P^{32}$, $N^{15}$, $O^{18}$ and $I^{131}$. Mention is also made of the use of radioactive elements as stimulators of growth in plants, and possible future uses of isotopes in plant studies are described. An extensive bibliography (161 references) appears with this article.

2977 Labeled Inorganic Sulfate in the Diagnosis of Cartilaginous Tumors and Their Metastases. Laurence L. Layton and Doris R. Frankel. Cancer 2, 1089-92(1949) Nov.

Biopsy samples from the centers of cartilagenous tumors, the periphery and neighboring normal tissue, and in some cases from neighboring muscle, were taken and prepared with bovine serum ultrafiltrate or Tyrode's solution to which had been added sodium sulfate, $S^{35}$. Details of the procedure are given, and tables of Geiger-Mueller counts on the tissue in each of six cases are given. In one case the diagnosis was not borne out by the differential sulfate fixation which indicated that the tumor was not cartilaginous in its sulfate metabolism; in another case the diagnosis was only partially confirmed, since the tumor was of mixed origin; in the remaining three cases the preliminary diagnosis was confirmed. Suggestions as to the preparation of the medium for incubation are given. The authors conclude that in adult human tissue there is a differential fixation or retention of sodium sulfate labeled with $S^{35}$ which may be used as a rapid confirmatory test for cartilaginous cancers and their metastases.

2978 Metabolism of Iron. Paul F. Hahn. Federation Proc. 7, 493-8(1948) Sept.

This is a review article on the use of $Fe^{59}$ in determining presence, fate, and action of iron in the body, including reports of work on distribution, absorption, valence state, uptake (especially during gestation), transport, inflammation in influence on uptake and utilization, hemoglobin pathways, and iron deficiency in anemia. 35 references.

2979 Non-Nucleic Acid Protein-Bound Phosphorus. J. N. Davidson, Mary Gardner, W. C. Hutchison, W. M. McIndoe, W. H. A. Raymond, and J. F. Shaw. Biochem. J. 44, xx(1949) No. 3.

To test the assumption that the protein-bound P remaining after acid tissue extracting is derived from ribonucleic acid and desoxyribonucleic acid, $P^{32}$ was fed to rats and rabbits, and the specific activity of the protein-bound P and each acid was determined. The authors found that the activity of the protein-bound P was much greater than that for the acids and isolated an active fraction from liver, spleen, thymus, and intestinal mucosa which contains very little P, but shows a very large activity. This fraction appears in cytoplasmic and nuclear material and has been isolated from liver cell nuclei.

2980 On Labeling Tubercle Bacteria with Radioactive Phosphorus (Preliminary Report). Lars Ström and Lars Rudbäck. Arvid Wallgren 60, 98-101(1949)

In order to determine the distribution of tubercle bacteria within an organism, various strains of tubercle bacteria were labeled with $P^{32}$ and, after repeated washing, were injected subcutaneously into the right thigh of guinea pigs weighing 350 g. The animals were sacrificed at intervals, and the activity per gram of tissue was determined for the lymph glands, spleen, lung, kidney, liver, heart, muscle, marrow, blood, and urine. The labeling procedure for the bacteria is described. Highest activity was found in the lymph glands and the bone marrow, irrespective of the time lapse between inoculation and detection; the activity of the spleen was small in comparison with that of the lymph glands. The authors concluded that it is reasonable to assume that the various values of activity demonstrated are the ratios between the amounts of bacteria which have become more or less firmly fixed in the organs.

2981 On the Renewal of the Purines of the Desoxypentose and Pentose Nucleic Acids. Sidney S. Furst, Paul M. Roll, and George Bosworth Brown. J. Biol. Chem. 183, 251-66(1950) Mar.

A number of experiments are described in which adult male rats of the Sherman strain were fed varying amounts of adenine labeled with $N^{15}$ in the 1 and 3 positions. On the afternoon of the day following the last feeding, the animals

were sacrificed either by decapitation or by injection of urethane followed by injection of magnesium sulfate; the organs to be tested were quickly removed and frozen. (1) The incorporation of dietary adenine into desoxypentose nucleic acids (DNA) and pentose nucleic acids (PNA) of pooled rat viscera, nongrowing rat liver or regenerating rat liver, or into the total nucleic acids of various rat organs, (2) the fractionation of liver nucleic acids with added labeled nucleic acid, and (3) the retention of isotopic adenine once it was incorporated into PNA and DNA of regenerating rat livers were investigated. It was found that in both nongrowing liver and total viscera the labeled adenine is rapidly incorporated into the purines of the PNA fraction, but only 1% as extensive in the purines of the DNA fraction. During rapid liver regeneration this incorporation into DNA was 75% of that into PNA, and when the animals were allowed an unsupplemented diet for 3 weeks, the purines of DNA were stable, while those of PNA were not. The extent of incorporation of the dietary adenine into DNA is concluded to be related to the extent of cell mitosis, while the dynamic state of the purines of PNA of liver is comparable to that of the protein of liver. 46 references. (auth)

2982 Phosphate Metabolism and the Dissociation of Anaerobic Glycolysis from Synthesis in the Presence of Sodium Azide. S. Spiegelman, M. D. Kamen, and M. Sussman. Arch. Biochem. 18, 409-36(1948) Sept.

To obtain direct evidence on the localization of azide interference in the phosphate metabolism of S. cerevisiae in anaerobic 48-hr cultures, controlled experiments using phosphate-$P^{32}$ in a glucose medium were performed which tested the effect of $NaN_3$ on P turnover, internal orthophosphate, glycolytic inhibitors of the triosephosphate dehydrogenase, sodium fluoride, and arsenate inhibition of glycolysis. The results are given in detail; these and other interpretations of azide effects, mechanisms of azide and acetyl phosphate replacement reactions, azide effects on other systems, and the mechanism and kinetics of azide action in various systems, including glycolytic activity, are extensively discussed. The authors conclude that azide uncouples anaerobic oxidation from synthesis by means of a replacement reaction between azide and the acetyl phosphate of diphosphoglycerate while the latter is combining with phosphopherase; the resulting azide, being unstable, would hydrolyze rapidly; the properties of the type of azide-poisoned fermentation observed can be interpreted in terms of this mechanism.

2983 Production of Radioactive Serum Albumin by Liver Slices. Theodore Peters, Jr., and Christian B. Anfinsen. J. Biol. Chem. 182, 171-9(1950) Jan.

The incorporation of $C^{14}O_2$ in the dicarboxylic acids of chicken-liver slices, with a turnover rate 2 to 3 times that previously observed, was tested by determining final $CO_2$ specific activity of the whole preparation and its various protein fractions. Results were obtained by low-temperature alcohol fractionation, and further by rabbit antiserum methods, ultracentrifugation, electrophoresis, and absorption spectra, which show no significantly higher rate of incorporation of the dicarboxylic acids into protein than the average slice protein; the alcohol fraction of the proteins which entered the medium during incubation had specific activities 8 to 16



times the activity of the slice, and immunological, ultracentrifugal, and electrophoretic tests show that this fraction consists of a protein indistinguishable from serum albumin. The authors conclude that this confirms earlier suggestions that the liver in the site of serum albumin formation.

2984 Radioisotopes in Entomology. Dale W. Jenkins and Charles C. Hassett. Nucleonics 6, 5-14(1950) Mar.

The use of radioisotopes in entomology may be divided into two phases: in the first type of application the isotope is used as a tool to study phenomena which it does not directly affect. Tracers have been used to study the migration, feeding, and breeding habits of many insects and to study the role of insects in spreading diseases, both in animals and in plants. Radioisotopes are also useful in determining the effect of radiation on the growth and reproduction of organisms. The authors believed that such techniques may eventually be very effective in developing methods of insect control. 41 references.

2985 Rates of Turnover and Biologic Decay of Chloride and Chloride Space in the Dog Determined with the Long-Life Isotope, $Cl^{36}$. G. E. Burch, S. A. Threefoot, and C. T. Ray. J. Lab. Clin. Med. 35, 331-47(1950) Mar.

This is an amplification of a paper presented before the Twenty-second Annual Meeting of the Central Society for Clinical Research in Chicago on Nov. 4 and 5, 1949. An abstract appeared in Nuclear Science Abstracts as No. 4-962.

2986 The Reaction of Mustard Gas with Skin Proteins. Richard A. Ormsbee, Frederick C. Henriques, Jr., and Eric G. Ball. Arch. Biochm. 21, 301-12(1949) Apr.

To investigate the nature of the compound to which the S of mustard gas labeled with $S^{35}$ is bound in skin applications, fractionation tests of skin areas were performed, resulting in significant amounts of $S^{35}$ being observed in 9 different fractions. Extractions with NaOH, phosphatase in Na veronal buffer, and autoclaves of the tissue preparation were also done; an amino acid composition test on one of the fractions was performed. The results show that most of the $S^{35}$ of the fixed mustard is combined with skin proteins which are insoluble in weak salt solutions; over half of this may be split off with weak alkali and heat; from this the authors conclude that this portion is combined with protein carboxyl groups. They also conclude that the type of linkage involved in the fixation of the other fractions is unknown, but its possible nature is discussed. Calculations show that only 1 to 2% of the total skin protein reacts with the mustard even in cases of severe burn.

2987 Relations Between the Rate of Renewal and the Intracellular Localization of Ribonucleic Acid. R. Jeener and D. Szafarz. Arch. Biochem. 26, 54-67(1950) Mar.

The relations between the rate of renewal and the intracellular localization of ribonucleic acid were studied, utilizing the liver of adult rats fasted for one night, the embryos of mice removed several days prior to parturition, and the cells of a colorless flagellate (Polytomella coeca) obtained by mass culture and used during the slow-down

phase of its period of multiplication; in all the experiments, sodium orthophosphate marked with $P^{32}$ was either injected subcutaneously (rats, pregnant mice) or introduced into the culture medium (Polytomella) 2 hr prior to the sampling and fractionation of the cells. The procedures for the fractionation of the cytoplasmic ribonucleic acid (RNA), isolation of the nuclei in rat liver, and determination of the specific radioactivity of the P of RNA are presented. It was found that in nonmultiplying cells, the specific radioactivity is strongest in the nuclei; within the cytoplasm, it decreases from the RNA fraction with the smallest speed of sedimentation to that with the highest speed of sedimentation. In multiplying cells, the distribution of the specific radioactivity of the P of cytoplasmic RNA is the same, aside from the fact that the radioactivity of the RNA of the particles showing the highest speed of sedimentation is practically equal to that of the cytoplasmic RNA with the lowest speed of sedimentation. An interpretation of these experimental facts is attempted for the case of nonmultiplying cells. 33 references. (auth)

2988 Studies on Protein Synthesis in Vitro. III: Further Observations on the Incorporation of Methionine into Liver Protein. M. V. Simpson and H. Tarver. Arch. Biochem. 25, 384-95(1950) Feb. (See also NSA 4-604.)

This paper deals with the development of methods to separate methionine sulfur from cystine sulfur and with the problem of showing that the noncystine sulfur incorporated into the liver protein is that of methionine; $S^{35}$ was used as a tracer. The effects of poisons, of anaerobic conditions, and of the level of methionine on the rate of uptake have also been examined. It was found that the uptake of methionine $S^{35}$ by the tissue slices was due to the formation of bonds and not due to adsorption; the synthetic system in the slices was partly inactivated in 2 hr at 0 to 5°C, and the process was inhibited by respiratory poisons, anaerobiosis, and by homogenizing the tissue. The rate of uptake depended on the concentration of methionine and was independent of the number of slices used; the uptake proceeded linearly over a period of 4 hr. The d-isomer inhibited the uptake of the l-isomer; glycine, aspartic acid, and glutamic acid appear to have little effect on the uptake of methionine. 15 references.

2989 A Study of the Synthesis of Melanine by the Cells of Melocarcinoma with the Help of Labeled Molecules. M. J. Berger and J. C. Reid. J. Radiol. Electrol 30, 341-4, (1949).

Transplants from a spontaneously developed melanoma, S-91, in a mouse of DBA strain were used for this study on mice of the same strain. The transplants were from 23 to 56 days old. Radioactive dl-tyrosine and dl-dopa (dihydroxyphenylalanine) were synthesized by the method developed by Reid (Science 105, 208(1947)). Radioactive tryptophane was prepared by Heidelberg's technique. These substances were labeled with $C^{14}$ in the $\beta$-position in the lateral chain. Nine-tenths milligram of tyrosine and dopa and 5.1 mg of tryptophane were injected in the central vein of the tail of the mice. The results obtained show that the tyrosine and the various other constituents are used by the granule to synthesize a protein similar to a matrix already present. This protein reacts with the enzymatic systems of the



granule, and the free tyrosyl groupings are oxidized. These oxidized groupings are polymerized without losing completely their link with the parent protein. The mechanism of incorporation of the tryptophane appears to be different from that of the tyrosine. The percentage of the total radioactivity of the tumor recovered in the form of melanine B is 7% for tryptophane and 20% for tyrosine. Dopa injected into the circulatory system is not transformed into melanine, although experiments in vitro showed that the first stage in the formation of melanine is the oxidation of tyrosine which is transformed into dopa.

2990 Tissue Culture Studies. III. The Relationship of Incorporation of Radioactive Phosphorus in Nucleic Acid to the Growth of Cells in Vitro. Wayne Hull and Paul L. Kirk. J. Gen. Physiol. 33, 335-42(1950) Mar. 20.

The rate and the extent of incorporation of tracer $P^{32}$ into the desoxyribonucleic acid fractions were investigated in order to determine whether they would operate as a sensitive method for evaluating certain aspects of the growth process in tissue cultures. Cultures made of the hearts of chick embryos 8 to 9 days old with an added culture medium of horse serum and embryo extract were used; about 0.05 to 0.1 mc of $P^{32}$ in the form of neutral orthophosphate was added to each milliliter of the culture medium. The cultures, after an interval of incubation, were tested for the incorporation of the isotope into the nucleic acid fractions; other experiments involved the use of 2-mc and 20-mc doses of $P^{32}$ in the culture medium to test the possible effects of irradiation on the tissue; no effects were noted. Growing cultures were shown to incorporate more of the isotope into the ribo- and desoxyribonucleic acid fractions than the nongrowing cultures used. The isotope incorporation into the desoxyribonucleic acid probably parallels the mitotic coefficient and serves as a sensitive index of synthesis of new cells. (auth)

2991 Tissue Culture Studies. IV. Growth of Tissue in Vitro as Related to the Direct Measurement of $P^{32}$ Uptake. Wayne Hull and Paul L. Kirk. J. Gen. Physiol. 33, 343-8(1950) Mar. 20.

An improved procedure for measuring the uptake of tracer $P^{32}$ by tissues in culture is described. It consists in counting the $\beta$ emissions through a specially designed roller tube in which the culture medium can be effectively removed from the system without opening or damaging the cultures. In standard growth-promoting medium, the uptake was shown to be markedly greater than in Tyrode's solution. The uptake curve was found to be essentially parallel with the uptake of $P^{32}$ in desoxyribo- and ribonucleic acids when standard medium was used and in desoxyribonucleic acid when Tyrode's solution was used. This is interpreted to signify that the total uptake of tracer phosphorus approximates the growth in the culture. The value of uptake measurements as a frame of reference for comparison of various types of media and of metabolic studies is indicated. (auth)

2992 Turnover and Distribution of Phosphate Compounds in Yeast Metabolism. Elliot Juni, Martin D. Kamen, John M. Reiner, and S. Spiegelman. Arch. Biochem. 18, 387-408(1949) Sept.

The distribution and turnover of P-containing compounds in S. cerevisiae incubated for 48 hr anaerobically in a glu-

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cose medium with exogenous inorganic orthophosphate-$P^{32}$, and in some cases with $(NH_4)_2SO_4$ in amounts required to limit division, were studied by determinations of P content and $P^{32}$ activity in various fractions of the culture such as acid-soluble compounds, phospholipids, phosphoproteins, and two nucleic acids. The turnover rate was taken to be a function of the specific activity of the various fractions with respect to time. Under the N conditions which enhanced the turnover rate of all fractions, a marked saturation equilibrium effect was noted in nucleic acids and in acid-soluble metaphosphate. The results of the experiments are given in detail, including a procedural scheme. The authors discuss possible relationships between the nucleic acids and the metaphosphate in terms of protein synthesis and consider some difficulties involved in interpretation of specific activity data with respect to metabolic systems.

2993 The Uptake of Labeled Glycine by Normal and Cancerous Tissues in the Rat. A. Clark Griffin, Lew Cunningham, Joseph D. Teresi, and J. Murray Luck. Cancer 3, 316-20(1950) Mar.

Labeled glycine $[C^{14}H_2(NH_2)COOH]$ was administered to Sprague-Dawley albino rats with azo-dye–induced hepatomas. The animals were sacrificed at 2, 6, 12, 24, 48, and 96 hr, and the isotope incorporation was determined in the cancerous and noncancerous hepatic tissue and also in other body tissues. Liver tissue and also liver protein showed a maximum incorporation of $C^{14}$ within 2 hr, while the tumor tissue did not reach a maximum until 12 hr following the administration of the glycine. Nucleoprotein fractions prepared from the nuclei and the cytoplasm of the liver tumors exhibited a delayed uptake of the isotope, as compared to the similar fractions obtained from the noncancerous liver. Of the tissues studied, liver, kidney, bone, serum, and spleen exhibited the greatest uptake of the isotope, while muscle was relatively inactive. 16 references. (auth)

2994 Use of Radioactive Isotopes in Study of Fungi and Bacteria. J. M. Hammer, I. A. Pearson, K. E. Corrigan, H. S. Hayden, and W. L. Mallmann. Am. J. Clin. Path. 20, 282-6(1950) Mar.

This article points out some of the dangers inherent to mold-spore studies utilizing radioactive substances as tracers. Because the mold spores are formed on aerial hyphae, any undue distrubance in the culture tube causes the spores to disperse in the air, contaminating the personnel and equipment with radioactivity. The authors developed a protective method consisting in adding fluid to cultures in order to wet the spores and disperse them into the solution rather than into the surrounding air; the method is described in detail. A technique is also described for the production of radioautographs of microorganisms; it served as a basis for a study of the metabolism of $I^{131}$ and $P^{32}$ by the microorganisms.

2995 The Usefulness of Radio-Active Substances in Studying Certain Aspects of Circulation in the Brain. Edward B. Schlesinger and Edith Quimby. Trans. Am. Neurol. Assoc. 94-6(1949).

Two radioactive methods which are used for determining the location of tumors in the brain are described, and a radioactive method for determining the rate of circulation in various parts of the brain is presented. With a counter

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in place over the sagittal sinus, a radioactive salt is injected into an antecubital vein, and the circulation time and local rate of decay of the radioactivity are measured at various points in the brain. The effects of various pathological states and drugs on the circulatory system may be investigated and evaluated. It is concluded that the collection of such particles of information as described with radioactive tools may be of general clinical use.

2996 Utilization of Choline and Betaine Methyl in the Guinea Pig. J. Dubnoff. Arch. Biochem. 22, 474-5(1949) July (Letter to the editor).

The availability of choline and betaine for methylation in the guinea pig was checked by injecting the animals intraperitoneally over a 3-day period with a total dose of 1 mM of one of these substances labeled in the methyl groups with $C^{14}$ containing $1.2 \times 10^6$ counts. Respiratory $CO_2$ was collected and analyzed; liver, kidney, and washed gut were frozen, ground, and extracted with alcohol and trichloracetic acid; the rest of the carcass was treated and analyzed for $S^{35}$-methyl groups. The results show that choline methyl is labile, but quantitatively less labile than betaine methyl in the guinea pig.

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2997 Physicochemical Studies of Beryllium Complexes. III. A Quantitative Investigation of the Beryllium Citrate Complex in Basic Media. R. Danley, I. Feldman, and W. F. Neuman. UR-105, Jan. 23, 1950. 18p.

Studies were made of slightly alkaline mixtures of beryllium and citrate employing techniques of dialysis. In a mixture of beryllium chloride and 0.025M $NaHCO_3$ at pH 8 to 8.5, the concentration of dialyzable beryllium was about 0.2 $\mu$g/ml. When citrate was also present in this mixture, the concentration of dialyzable beryllium increased in direct proportion to the initial concentration of citrate. Hence, if the soluble beryllium concentration is large compared to 0.2 $\mu$g/ml, the concentration of beryllium which is dialyzable when citrate is present is a measure of the beryllium citrate complex formed. Using the Method of Continuous Variations (Job, Ann. chim., 11, 97(1936); Vosburgh and Copper, J. Am. Chem. Soc., 63, 437(1941)), it was found that when beryllium and citrate were present in a molar ratio of 2 or more at pH 8 to 8.5, they combined in a ratio of 2 to form a soluble (dialyzable) complex which was less than 5 dissociated. As the pH was raised, this complex dissociated further to give a precipitate, presumably beryllium hydroxide. Though the precipitation was reversible, it was shown by ultrafiltration that a large excess of citrate was required to make solubilization take place completely within a few hours. Ultrafiltration of blood sera containing added beryllium and citrate showed that the solubility of beryllium added to blood serum can be increased markedly by the addition of excess citrate. In a previous study (UR-59) ultrafiltration of beryllium citrate-beryllium hydroxide mixtures showed that citrate is one blood constituent likely fo form a soluble complex sufficiently undissociated to be of toxicologic significance. It was also learned that the filtrability of beryllium at basic pH caused by its complexing with citrate is much greater when the complex is formed before the pH is raised to the value at which beryllium

hydroxide normally precipitates. Because of adsorption of beryllium on the metal ultrafilter, the previous work allowed qualitative interpretations only. Consequently, an all-glass apparatus (UR-62) was devised to reduce the errors due to adsorption. With the new apparatus, the earlier experiments have been repeated, and the results coupled with those of dialysis studies have enabled a quantitative investigation of the complexing of beryllium by citrate. (auth)

2998 A Study of the Chemistry of [Niobium], Tantalum, and Some Associated Transition Elements; Final Report Covering the Period January 1, 1948, to October 31, 1949. Polytechnic Institute of Brooklyn, nd. 19p. (AEC File No. NP-1266.)

A method of complete chlorination of niobium oxide and some related oxides at atmospheric pressure in a simple reflux and distillation apparatus was found with octachloropropane ($C_3Cl_8$). The reaction is quantitative with niobic oxide. Titanium dioxide alone does not react, but in the presence of niobic oxide reacts completely under certain conditions. Tantalum pentoxide reacts with difficulty, but in the presence of niobic oxide chlorinates more readily (although not completely). It is necessary to use pure octachloropropane and to ignite the various oxides at high temperatues in order to obtain the maximum conversion to chloride. A standardized method of synthesizing niobium pentachloride at atmospheric pressure, with a high yield and high purity, was achieved. The organic products of the chlorination were determined. The reaction appears to be acid-catalyzed. A number of other transition oxides were chlorinated by means of octachloropropane at atmospheric pressure. Increased basicity of oxide means less chlorination product. A modification in the apparatus permitted the quantitative separation of titanium and the quantitative retention of niobium. Spectroscopically pure niobic oxide was prepared. Other oxides, except for ferric oxide, did not interfere in the separation. Columbite ores could not be chlorinated at atmospheric pressure. The suggested analytical procedure for ores involves pyrosulfate removal of iron, manganese, and tin as sulfides, removal of titanium by chlorination, and determination of tantalum in the presence of niobium colorimetrically. The latter determination is very sensitive to impurities. The chemistry of trivalent niobium ion, produced electrolytically, was qualitatively investigated. The reduction in sulfuric acid was not complete, and some hydrogen sulfide was evolved. Some preliminary absorption spectra were taken. Anhydrous niobium pentachloride dissolved in carbon disulfide was found to react with potassium iodide to yield a dark precipitate, some dissolved material and iodine. No simple stoichiometric relations emerged from the quantitative assay of precipitate and solution. The niobium in the precipitate was in a reduced form. 10 references. (auth)

2999 Bibliography of Polarographic Literature. Leeds and Northrup Company Report No. E-90(1), 1950. 102p.

In this publication, the bibliography of polarographic literature first issued by Leeds and Northrup Company in 1941 has been greatly expanded and brought up to date as of mid-1949. More than 2,200 articles dealing with the polarographic method and its applications have appeared since 1922, the first use of the dropping-mercury cathode in analysis of metal ions in aqueous solutions.



3000 Neutron Spectroscopy for Chemical Analysis—II. Resonance Effects, Transmission in the $1/v$ region. W. W. Havens, Jr. and T. I. Taylor. Nucleonics 6, 66-77(1950) Feb.

The author outlines a general method for obtaining the total cross section of an element for neutron interactions, and plots the relation between the total cross section of tantalum and the neutron energy. This curve may be used to detect tantalum or to determine the percentage of tantalum in a mixture of elements. Principal resonances are given for a number of other elements. These resonances may also be used for qualitative and quantitative tests to detect the presence of the elements. The use of resonance absorption and scattering curves in chemical analysis is described in detail, and the amount of indium impurity in a sample of tin is determined in a sample calculation.

3001 Observations in Ultra-Violet Light Applied in Chemical Adsorption Analysis. E. M. Brumberg and S. A. Gershgorin. Doklady Akad. Nauk S.S.S.R. 69, 801-4(1949) (in Russian).

Chromatographic analysis can be extended so as to include colorless substances that are luminescent in the ultraviolet light. In the authors' photographic method the chromatographic paper (or column) is successively photographed, using a quartz-NaCl objective, in the ultraviolet light of wave lengths 365, 313 and 280-250 m$\mu$, obtained with a mercury lamp and various light filters; the three photographs are viewed through a "chromoscope" giving one picture in conventional colors, (described by Brumberg, Izvestiya Akad. Nauk S.S.S.R., Ser. Fiz. 6, 32(1942)). In another, the visual, method, a specially constructed telescope is used, in which the ultraviolet image of the chromatogram is projected upon a fluorescent screen that gives a visible image; by using composite fluorescent screens, made of several colored layers, colored images of the chromatogram can be obtained. A simplified visual method consists in viewing, through a plate of fluorescent substance (uranium glass), the ultraviolet light that has traversed a filter-paper chromatogram.

3002 Recent Progress in Organic Microanalysis. Ernest Kahane. Bull. soc. chim. France, D.1-D.12(1950) Jan.-Feb. (In French).

This article offers a review of recent work in microanalysis. Among the methods employed in this field is mass spectrography for identification of gases and for improvements of microdetermination of various elements and compounds. An extensive bibliography is included.

3003 A Simple "X-Ray Colorimeter". A. Engstrom and L. Wegstedt. Acta Chem. Scand. 3, 1442-4(1949). (Short communication)

This paper describes a method permitting the rapid determination of the amount of a heavy element bound to an organic compound. As the absorption of x-rays increases with the fourth power of the atomic number, an organic compound to which a small amount of a high atomic element

is bound gives greater absorption of x-rays than the organic compound alone. In the experimental arrangement described, the x-rays pass through the substance to be analyzed and fall on a fluorescent screen. The intensity of the fluorescence is measured with a photo-multiplier whose output is fed to a galvanometer. A calibration procedure is described.

3004 A Hundred Years of Research on Atomic Weights. Klaus Clusius. Munich, Bavarian Academy of Science, 1949. 28p. (in German).

A short history of atomic weights and the methods used for their determination.

3005 The Crystal Structure of $Th(OH)_2CrO_4.H_2O$; The $Th(OH)_2$- Chain, a New Structural Element. Georg Lundgren and Lars Gunnar Sillén. Naturwissenschaften 11, 345-6(1949)(in German).

By means of crystallographic analysis, the $Th(OH)_2CrO_4.H_2O$ crystal was found to have the following structure:

Symmetry: monocline, space group $C_{2h}^2$-$P2_1/m$,

$$a = (7.66_2 \pm 0.01)\ kX,$$

$$b = (6.10_1 \pm 0.01)\ kX,\ \beta = 113.87° \pm 0.05°$$

In the $Th(OH)_2$- chain, each throium atom is surrounded by eight oxygen atoms at a distance of approximately 2.5 A. These oxygen atoms form two squares which make an angle of ~45° with respect to each other, but whose planes are parallel.

3006 An X-ray Scanning Camera. J. Thewlis and A. R. Pollock. J. Sci. Instruments 27, 72-3(1950) Mar.

An x-ray scanning camera is described which is designed to eliminate spottiness from x-ray photographs of coarse-grained material, for work on crystalline orientation. It may also be used for averaging the orientation over a selected area of a fine-grained specimen or for determining average compositions. It is suitable for back-reflection, transmission or glancing-angle photographs, and the angle of incidence can be varied from 0 to 90°. Provision is made for increasing the completeness of the scan if the specimen grains are so coarse that the x-ray lines are not sufficiently smoothed out when the scanner is used in the normal way. (auth)

3007 Synthesis of Greatly Enriched HD. Francis J. Norton. Science 111, 202-4(1950) Feb. 24 (Technical paper).

The author has devised a method of synthesizing enriched HD by means of a two-step process. This process consists of a complete deuteration of $B_2H_6$ by $D_2$, followed by the slow reaction of $B_2D_6$ with $H_2O$ producing HD. Thus 85% concentrations of HD may be attained. This process is described in detail. Mass spectra are given for the concentrated preparation and for the residual gas (composed of a mixture of $H_2$ and $D_2$) before and after equilibration by heating on a Ni filament.

3008 Determination of Small Quantities of Fluorine by Amperometric Titration. G. S. Luzina. Zavodskaya Lab. 15, 1412-1414(1949)(in Russian).

It is shown that the amperometric titration of fluorine (Lange, Ind. Eng. Chem. Analyt. Edition 12, 511(1940)) permits determinations of F in quantities as small as 0.005 mg, and that the influence of admixtures is weaker than in other methods. The reagent used is 0.01N $Th(NO_3)_4$ solution, forming with $F^-$ the insoluble thorium fluoride. The titration takes place, at 1.7 v, in a polarographic setup having a Hg dropping cathode and a calomel anode, with 0.1N KCl solution as an electrolyte, to which the $F^-$ solution is added; a mirror galvanometer serves as an indicator. Every addition of the reagent is followed by an agitation with a H stream. It was found that the presence of O, Ca, Br, I, chlorides, and sulfates (up to certain limits) does not affect the results, while that of Al, Mg, phosphates, and arsenates (even in small concentrations) does. Temperature variations, within a few degrees, do not affect the exactitude of the analysis.

3009 Enthalpy-Concentration Diagram for HF-$H_2O$ System at One Atmosphere. Mack Tyner. Chem. Eng. Progress 45, 49-50(1949) Jan.

By means of the latest available data on aqueous hydrofluoric acid solutions, an enthalpy vs concentration chart is constructed. This is expected to be useful in avoiding complex concepts in the solution of problems involving heat effects accompanying concentration changes.

3010 On a Colorimetric Determination of Fluorine Ion. D. Monnier, R. Vaucher and P. Wenger. Helv. Chim. Acta 33, 1-10(1949). (In French)

The colorimetric determination of the $F^-$ ion with the aid of the reagent titanium ion + hydrogen peroxide was systematically studied. The reactions involved are the following: (1) $Ti^{+4}$ (colorless) + $H_2O_2 \rightleftharpoons TiO_2^{+2}$ (yellow) + $2H^+$; then (2) $Ti^{+4} + 6F^- \rightleftharpoons TiF_6^{-2}$, whereby the equilibrium of (1) is displaced toward the left and the color becomes lighter. The disturbing influence of the following ions was studied: $Fe^{+3}$ is colored, $Al^{+3}$ forms a complex with fluorine that is more stable than $TF_6^{-2}$, while $PO_4^{-3}$ and $SO_4^{-2}$ form complexes with titanium. When phosphates are present in large quantities, a modified method is used, based on the property of $Al^{+3}$ just mentioned: after (1) and (2), an excess of aluminum ion is added, whereby all fluorine of (2) goes to form $AlF^{+2}$ and the original color of (1) is restored; (the color variation permits the determination of F. To obtain the reagent employed in the present work, 0.0366 g-ion of Ti (using the chloride or the sulfate) was mixed with 100 $cm^3$ $H_2O$, 60 $cm^3$ perhydrol and 100 $cm^3$ $H_2SO_4$ (spec. gravity 1.84), after which $H_2O$ was added to complete the liter, and the solution was diluted 10 times.

3011 The Behavior of Electrodes in a High Intensity Radiation Field. E. M. Kinderman and W. N. Carson, Jr. HW-16079, Feb. 20, 1950. 28p.

The presence of radioactive materials in samples presented for analyses makes desirable the use of remote control and automatic methods for those analyses. Fundamental parts of many automatic methods are electrodes and electrode systems of various kinds. If these electrodes are to be used, they must be stable in the material to be analyzed. Excessive radiation as a possible cause of electrode instability has been suggested, and the work reported here was designed to investigate this possibility. A number of electrodes were immersed in a solution with a high intensity of radiation. The radiation was initially 2.2 curie/liter, this being principally $\beta$ radiation from $P^{32}$. The

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electrical potential of combinations of these electrodes was observed as a function of time of exposure to radiation. Analysis of the observations was made to determine which electrodes were useful in the radiation field. Reproducibility of electrode potential for periods of 3 to 6 days was demonstrated for the silver-silver chloride and calomel electrodes. Reproducible polarograms were obtained with the dropping mercury electrode for 2 days of exposure. An antimony electrode showed fair stability for not longer than 15 hr. Various glass electrodes showed good stability for from 8 to 24 hr; longer periods of radiation exposure resulted in measurement fluctuation and/or drift with these electrodes. One test with the glass electrode in the active solution showed correspondence between measured pH and indicator color. Other electrodes tested showed considerable variation in potential caused either by the electrolyte or by the radiation. These electrodes were stationary mercury and tungsten which were adversely affected by the radiation and carbon and platinum which are affected by the solution and possibly by the radiation.

3012 Hot Atom Chemistry. Willard F. Libby. Sci. American 182, 44-7(1950)Mar.

The behavior of neutron irradiated iodine in ethyl iodide is described, in a qualitative manner, as an example of the Szilard-Chalmers process and of the types of reactions entered into by the recoil atoms.

3013 The Solids Condensed from Carbon Monoxide by Alpha Particles. John H. L. Watson, Marcel Vanpee, and S. C. Lind. J. Phys. and Colloid Chem. 54, 391-401(1950) Mar.

Carbon monoxide, when polymerized by $\gamma$ rays from radon, exhibits a particulate structure. The particles have recognizable shape and have nearly the same dimensions in all directions. There are two components in the residue. The first consists of solid particles which are rigid aggregates of graphitic flakes. The second is a viscous liquid material which surrounds the particles, may exist within them, and often joins them one to the other by short necks. The mean diameter of the material taken from the base of the flask is about 0.5 $\mu$ and that of the material from the neck of the flask about 0.41 $\mu$. About 15% of the silhouette images of the particles appear hexagonal in shape. The percentage of particles having this shape is undoubtedly even higher than this, since nonhexagonal images often are accompanied by hexagonal shadows. The approximate uniformity of particle dimensions in all directions and the increase in particle size toward the base of the flask indicate that the particles are formed and grow in the gas phase, and that the larger ones fall out under gravity. Many, both large and small, also diffuse to the walls. (auth)

3014 The Energetics of the Lanthanide Ions. K. B. Yatsimirskiĭ. Izvest. Akad. Nauk S.S.S.R., Otd. Khim. Nauk, No. 6, 648-52(1949)(in Russian).

Thermochemical characteristics of rare earths, such as ionization potentials, and hydration and formation heats, of their trivalent ions, were determined by using the equation of Kapustinskiĭ (Zhur. Obshcheĭ Khim. 13, 497(1943)) and the known thermochemical data. Thus, the formation heats $-H_R$ of the gaseous ions $La^{+3}$, $Ce^{+3}$, $Pr^{+3}$, $Nd^{+3}$, $Gd^{+3}$, $Dy^{+3}$, $Ho^{+3}$, $Er^{+3}$, $Tm^{+3}$, and $Lu^{+3}$ were found from $-H_R = 3H_{Cl^-} - U_{RCl_3} - H_{RCl_3}$, where $H_{Cl^-}$ and $-H_{RCl_3}$ are formation heats of the gaseous $Cl^-$ and the solid salt, respectively, and $U_{RCl_3}$ is the energy of the latter's lattice, calculated from Kapustinskiĭ's equation. Since the formation heat of a gaseous ion is the sum of the metal's sublimation and ionization heats, and since the ionization heat is approximately equal to the ionization potential I, the latter can be calculated, by using the value 90 kcal for the sublimation heat of the lanthanides. The values found satisfy the equation $I = 43.18 \log Z - 38.9$, from which the ionization potential of the element 61, $Eu^{+3}$, $Tb^{+3}$, and $Yb^{+3}$, can be calculated. Further, the hydration heats $L_R = -H_{aq} + H_R - 3 \times 101$, where 101 kcal is the heat of formation of a H ion in water solution, and the difference $H_{aq} - 303$ is the heat of formation of a trivalent lanthanide ion in water solution. The values thus calculated satisfy the equation $L_R = 382 + 515/r$, where r is the ion radius. By using the material obtained in the present work, an estimation can be made of the heats of formation of various compounds, such as chlorides, hydroxides, oxides, nitrates, sulfates, etc., of the lanthanides.

3015 Investigations of Rare Earth Problems; Quarterly Progress Report No. 11 Covering the Period December 1, 1948, to March 1, 1949. University of Illinois, nd. 42p. (AEC File No. NP-1342.)

Spectrophotometric Studies on the Rare Earths. Some studies on the analytical applications are given. The absorption spectrum of cerium (III) chloride has been measured in the ultra-violet. Further studies on ytterbium and thulium chloride solutions and their adherence to Beer's Law are presented. Beer's Law is shown to be obeyed by both metals in chloride solutions. A correction to the k value for ytterbium chloride solutions is given. A study of the effects of excess perchlorate ion on erbium perchlorate solutions has been made, and a procedure for preparing virtually acid-free solutions for analysis is given. A study of the effects of chloride ion on erbium perchlorate solutions as related to the absorption spectrum has been started.

Complexes of the Rare Earths with Ethylene Diamine Tetracetic Acid. A literature survey and preliminary experiments were begun on Feb. 1. A proposed quantitative approach to determining the stability and composition of the complexes is outlined, and results so far indicate that neodymium can be complexed with Sequestrene (ethylene diamine tetracetic acid) to such an extent that neodymium hydroxide does not precipitate below pH 10.5.

Ion Exchange Studies Involving the Lanthanons. The results from runs 3 and 4, the elution of sample Pr 9 recorded in Quarterly Progress Report No. 10, are concluded with the presentation of tables of per cent recovery and per cent composition of the fractions. The removal of ferric iron from the samples by means of isopropyl ether extraction was found effective. The procedure involved in the purification of Dowex 50 resin was developed satisfactorily. This resin was employed in preliminary experiments upon the elution of the lanthanons with the mono-ammonium salt of ethylene diamine tetracetic acid. Initial results indicate possible developemnt of a means of separation based upon the complexing ability of this reagent.

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The Stabilization of the Higher Valence States of Praseodymium. A "direct" approach to the problem of separating praseodymium from mixtures of rare earth oxides, by which is meant the endeavor to discover an efficient means of separation utilizing methods which are of necessity largely of a trial and error nature, has not been successful. It is believed that this is chiefly due to a lack of specific and accurate information concerning the properties of the rare earth substances involved in the investigation. Until such data has been obtained, certain other phases of the problem are to be studied, including an attempt to prepare a higher valent fluoride of praseodymium. A scientific report on the previous work of the author and others on the concentration of praseodymium is at present in the course of compilation.

Composition and Structure of the Oxides and Hydrous Oxides of Praseodymium. Work is being continued on the development of a gravimetric method for determining the active oxygen content in the black oxides of praseodymium. Hydrazine hydrate is being used as the precipitant for $Pr(OH)_3$ to form a coarse, easily filterable product. Dehydration curves for $Pr(OH)_3 \cdot xH_2O$ indicate that long periods of heating may be necessary to form the "anhydrous" hydroxide. The composition of praseodymium oxides prepared under varying conditions are being studied.

Hypophosphate Studies. Procedures for carrying out exchange reactions between hypophosphate and radioactive phosphate and between hypophosphate and radioactive pyrophosphate are outlined. Such an exchange would suggest a simple method for obtaining the radioactive hypophosphate necessary in this investigation. The results of the exchanges at varying pH values and temperature are included. These results incidate no exchange with the phosphate and the need for further investigation with the pyrophosphate.

8-Hydroxyquinoline and Substituted 8-Hydroxyquinoline Derivatives of the Rare Earth Elements. Experiments on the preparation of rare earth oxinates in the presence of a tartrate buffer and in very dilute solution have been completed. The chlorination of oxine in carbon tetrachloride has been attempted but without success, probably because of monochloroxine formation. The absorption spectra of dichloroxine in chloroform and of several chloroform solutions of the neodymium-dichloroxine complex are represented graphically. A third extraction has been made with gradually increasing pH values, and the resulting absorption curves are presented. (auth)

3016 Observations on the Rare Earths. LVI. Spectrophotometric Studies on Colloidal "Lanthanum Blue." Therald Moeller and Gladys Helen Quinty. J. Phys. and Colloid Chem. 54, 315-21(1950) Mar.

The conditions necessary for the reproducible preparation of stable lanthanum blue sols cortaining acetate or propionate have been determined. The absorption spectra of such sols have been measured over the spectral range 400 to 700 mμ as functions of the lanthanum, iodine, and organic anion contents and have been found to be characterized by single broad absorption bands centering at 580 mμ and 600 mμ, respectively, for acetate and propionate systems. For both acetate and propionate systems, absorption at these wavelengths has been related to iodine content by Beer's law up to $5 \times 10^{-5}$ moles of iodine per liter. Beer's law has been found to apply only roughly in the acetate sols

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as the lanthanum content increases to 0.02 mole per liter. Intensity of absorption has been shown to be unrelated to organic anion concentration when the latter is insufficient to effect flocculation of the sols. Use of lanthanum blue sols has been proposed for the colorimetric estimation of iodine in small quantities. Of the tripositive ions yttrium, samarium, and neodymium, only the last has been found to yield blue sols in the presence of iodine, alkali, and acetate or propionate. Absorption spectra of such sols have been found to be comparable with those for the lanthanum blues. 16 references. (auth)

3017 The Application of Anion-Exchange Resins to the Chromatographic Separation of Yeast Ribonucleic Acid from Its Smaller Degradation Products. Rene A. Bolomey and Leon Wish. ORNL-627, Mar. 27, 1950. 18p.

The present investigation deals with the choice of suitable conditions for the purification and the quantitative recovery of a commerical ribonucleic acid. It has been found possible to separate phosphoric, adenylic, and guanylic acids from ribonucleic acid, and to quantitatively recover the ribonucleic acid by chromatography on the anion-exchange resin Dowex-2. The resins Amberlite IRA-400 and Duolite A-3 were also investigated and were found to result in low recoveries of the adsorbed ribonucleic acid. 23 references.

3018 The Separation of Zr and Nb Oxalato Complexes by Anionic Exchange. R. E. Wacker and W. H. Baldwin ORNL-637, Mar. 23, 1950. 6p.

It has been found that Zr and Nb are adsorbed on Dowex-1 resin from oxalic acid solution (0.1 to 0.4M) and can be preferentially eluted (Zr being removed first) with 1M HCl and 0.01M oxalic acid solution. Results of separation studies using $Zr^{95}$ and $Nb^{95}$ as radioactive tracers are presented.

3019 Preparation of Carrier-Free Iron-59. A. W. Kenny, W. R. E. Maton, and W. T. Spragg. Nature 165, 483(1950) Mar. (Letter to the editor.)

The isotope $Fe^{59}$ can be produced by an (n,p) reaction on $Co^{59}$. All previously reported preparation of $Fe^{59}$ from irradiated cobalt have been diluted with more or less inactive iron, derived either from deliberately added carrier, or from impurities in the original cobalt. The authors found that the isotope can be extracted carrier-free into xylene as acetylacetonate. The extraction is quantitative provided the aqueous solution of the cobalt is in the pH range 4.0 to 7.0.

3020 The Separation of Pentose and Desoxypentose Nucleic Acids from Isolated Mouse Liver Cell Nuclei. Cyrus P. Barnum, Charles W. Nash, Elizabeth Jennings, Oddvar Nygaard, and Halvor Vermund. Arch. Biochem. 25, 376-83(1950) Feb.

Nuclei have been isolated from the liver tissue of normal male mice in a series of experiments by a procedure of differential centrifugation in citric acid, a porcess somewhat similar to that used by Marshak (J. Gen. Physiol. 25, 275(1941)). A 73% yield of nuclei was obtained by the method described; the nuclei contained 66% protein, 27% DNA (desoxypentose nucleic acid), 3.4% PNA (pentose nucleic acid) and 3.4% phospholipid. Purified DNA could

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be isolated from these nuclei with a yield of 95% and an N:P ratio of 1.74. Purified PNA could be isolated from the nuclei with a yield of about 45%; all the phosphorus present upon analysis could be accounted for as PNA. Following other experiments in which inorganic radiophosphorus was injected intraperitoneally an hour before the sacrifice of the mice, it was found that the specific activity of the subsequently isolated nuclear PNA was many times greater than that of the cytoplasmic PNA. The contamination factors for DNA and PNA are discussed. 19 references. (auth)

3021 Synthesis of 1-$C^{14}$-L-Ascorbic Acid. J. J. Burns and C. G. King. Science 111, 257-8(1950) Mar. 10.

In the course of a research on the biological functions of L-ascorbic acid, synthetic 1-$C^{14}$-L-ascorbic acid was prepared starting with L-xylose. The latter was converted into L-xylosone, from which by adding $C^{14}$-labeled cyanide, imino-L-ascorbic acid was obtained; this was hydrolyzed into L-ascorbic acid which was then purified in ion-exchange amberlite columns. The radioactive product contained approximately 75% of carrier ascorbic acid, added to facilitate crystallization in the course of the synthesis; the final yield was about 25% based on the labeled NaCN; the activity was $2.10 \times 10^8$ cpm/mg.

3022 Introduction of Substituents in the Aromatic Nucleus. Exploration of Its Mechanism by Means of Isotopic Hydrogen. Lars Melander. Acta Chem. Scand. 3, 95-6(1949) (Short communication).

The heavy isotopes of hydrogen, deuterium and tritium offer a means of determining the slow step of some of the common reactions by which substituents are introduced in the benzene nucleus. Hitherto it has not been settled whether the nitration, bromination, alkylation, etc., of benzene and related compounds are true substitutions (of the $S_E2$ type) or primarily additions of the positive ion to the aromatic nucleus by means of the $\pi$ electrons of the latter. By means of tracer amounts of tritium and comparison of the specific radioactivity of the reactants and the products, it has been shown elsewhere by the author that the nitration of toluene and benzene (two nitro groups introduced by means of nitric-sulphuric acid mixture) follows the $\pi$-complex mechanism. Other substitution reactions are mentioned as being investigated in the same manner.

3023 Self-Diffusion and Ionic Conductivity of the Sodium Ion in Sodium Chloride. Dillon Mapother. Carnegie Institute of Technology Technical Report No. 8, June 1949. 89p. (AEC File No. NP-1211.)

Radioactive tracer methods have been employed to measure the self-diffusion coefficient for the sodium ion in sodium chloride in the temperature range from 350 to 700°C. The observed values have been compared with values computed from the measured electrical conductivity using the Einstein Relation. The predictions of the Einstein Relation have been found to be valid at the higher temperatures (above 550°C), however the directly measured diffusion coefficient is greater than that calculated from the conductivity by a factor of about 2 at the lower temperatures. The suggestion is made that this discrepancy is due to the presence of positive multivalent impurities which associated with single positive vacancies in the crystal lattice to form "complexes." It is shown that such "complexes" do not have an electrical

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mobility and thus cannot contribute to the conductivity. Special microtomes, developed for preparation of the crystal samples, are described in detail. Appendixes cover the Einstein Relation and application of the diffusion equation. 20 references.

3024 Compounds of Thorium and Quadrivalent Uranium with Benzoylacetone and Dibenzoylmethane. Wilhelm Forsling. Acta Chem. Scand. 3, 1133-6(1949).

Preparations of thorium benzoylacetonate, thorium dibenzoylmethane, uranium (IV)benzoylacetone, and uranium(IV)-dibenzoylmethane have been described. The method to prepare uranium((IV)acetylacetonate given by Biltz and Clinch is mentioned. (auth)

3025 Compounds of Uranium with the Transition Metals of the First Long Period. N. C. Baenziger, et al. Acta Cryst. 3, 34-40(1950)

In the alloy systems of uranium with Mn, Fe, Co, and Ni, the following compounds occur: $U_6Mn$, $U_6Fe$, $U_6Co$, and $U_6Ni$, all tetragonal and isostructural, and of a new structural type; UCo, a body-centered cubic compound, Z = 8, with a unique structure; UNi, structure undetermined; $UMn_2$, $UFe_2$, and $UCo_2$, with the C-15 structure; $UNi_2$, with the C-14 structure; $UNi_5$ with the $PdBe_5$ structure, closely related to the C-15 structure. In addition, $UCu_5$ has a similar structure. Lattice constants and full structure determinations are reported for all compounds except UNi. For the latter, only powder data have been available, and the structure is complex. (auth)

3026 The Effect of Bicarbonate on the Colorimetric Determination of Uranium. T. R. Scott. Analyst 75, 100-4(1950) Feb.

When peruranate colors are to be developed in sodium carbonate solutions in the hydrogen peroxide method of determining uranium, the presence of bicarbonate in the solution causes errors. Their magnitude and means of avoiding them are considered. They may be eliminated by conducting the preliminary neutralization of the solution with sodium hydroxide and measuring the peruranate color within a few hours of making the solution alkaline with sodium carbonate. If readings are made at 445 m$\mu$, no error occurs even in presence of bicarbonate, but the sensitivity is much less than at 360 m$\mu$. The decrease in color at this lower wavelength is attributed to the conversion of higher to lower peruranates, the latter increasing in amount as the pH of the solutions is decreased. (auth)

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3027 Electric Furance with "Kryptol" Resistors. Jean Bernot. J. Four Electrique Ind. Electrochim. 58, 111-13(1949) Sept.-Oct. (in French).

An electric furnace is described which is improved by the addition of an automatic temperature regulating device, called "Kryptol." Kryptol is a form of carbon which was introduced as a resistance material many years ago. Superiority over other materials is claimed and various applications are described.

3028 Glossary of Nuclear Energy Terms. Section V. Chemical Engineering (prelim. ed.). National

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Research Council Conference on Glossary of Terms in Nuclear Science and Technology. New York, American Society of Mechanical Engineers, Jan. 1950. 32p.

The inclusion of terms has been limited to (1) those peculiar to the field of nuclear energy, (2) those used in this field in a different sense or with a different emphasis from what is most commonly used in other connections, and (3) those used elsewhere in the same way, but so infrequently as to be unfamiliar.

3029 Successful Application of Atomic Energy in Dyeing. Rayon and Synthetic Textiles 31, 79-80(1950) Jan.

A new textile dyeing process is described by which several types of apparel fabrics may be photo-chemically vat-dyed by the use of a newly discovered radioactive source material, UA-1. The process can proceed at varying rates of speed depending upon the fabric being dyed. In order to accomplish this, addition agents are included in the dye solution which coats the fabric. This catalytic addition agent, designated UA-1, is manufactured from radioactive materials. Very small amounts of this compound, when added to the solution coated on the fabric, increases the efficiency of outside radiation many thousandfold to a point where color can be precipitated on almost any material at high rates of speed. The process has been tried with promising results on plastics and other materials.

3030 Exposure Graphs for Radium Radiography of Steel. A. Morrison. National Research Council of Canada Report No. NRC-2009, nd. 9p.

Graphs are presented from which the exposure time required for the radium radiography of steel for several of the popular types of film can easily be obtained. A brief discussion of the graphs and instructions for using them are given.

3031 Material Required to Carry out Radiography with $Co^{60}$ or Radium. A. Morrison. National Research Council of Canada Report No. NRC-2008, Aug. 25, 1949. 11p.

The general requirements for industrial radiography are: a source of radiation, film to record the radiation, a room in which the radiographs can be made, a darkroom in which the films can be prepared for exposure and later developed, an illuminator for examining the films, and a place in which they can be stored. Each of these requirements is discussed in this report. (auth)

3032 The Use of Cobalt 60 for Industrial Radiography. A. Morrison. National Research Council of Canada Report No. NRC-2010, nd. 34p. (See also NSA 4-1436.)

Concentrated sources of $Co^{60}$, suitable for use as a replacement for radium in industrial radiography of steel have recently been made available from the Canadian nuclear reactor at Chalk River, Ontario. Graphs, from which exposure times for a range of thicknesses of steel and for different types of films can be determined, are given; and other information useful in handling and shipping $Co^{60}$ is presented. 10 references. (auth)

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3033 Radioactive Materials as Valuable Aids in the Textile Industry. H. Busath. Kunstseide Zellwolle 27, 236-7(1949).

This is a review of the use of radioactive materials in measuring the thickness of films, the thickness and degree of removal of sizing agents, the control and concentration of dyes, the control of xanthation, and the removal of $CS_2$ in the viscose industry.
(Taken from Chem. Abstracts 43, 8665(1949) Nov. 25).

3034 A Selected Bibliography on the Industrial Uses of Radioactive Materials. Arthur D. Little, Inc., Mar. 1949. 17p. (AEC File No. NP-1422.)

The references, some of which are briefly annotated, are grouped under general background articles, survey articles of industrial applications, and references dealing with specific fields as follows: petroleum, mining and metallurgy, textiles, instruments, radiography, analysis, pharmaceutical, glass, radioisotope preparation, and miscellaneous industrial applications.

3035 An Audible Vacuum-leak Indicator. J. T. Lloyd. J. Sci. Instruments 27, 76-7(1950) Mar. (Laboratory and workshop note).

An apparatus is described which is suitable for indicating pressure changes over the range from 10 mm to less than 0.1 mm of mercury. It employs a two-electrode discharge tube whose electrical characteristics depend on the nature and pressure of the gas it contains. If such a tube is inserted in a vacuum line and used as a variable factor in a simple relaxation oscillator circuit, the oscillation frequency, made audible by a loudspeaker, will serve as an indicator of the discharge conditions. The device is stated to be particularly useful for testing Geiger-Mueller counters using a two-stage rotary pump.

3036 Method of Supplying Low Pressure Gases on a Vacuum System. Raymond H. McFee. Rev. Sci. Instruments 21, 100-101(1950) Jan. (Laboratory and shop note).

This article describes a method which has been in use for several months for supplying a controlled, low-pressure atmosphere to a vacuum system manifold for the purpose of processing photoconductive cells. A diagram of the system is given. It is essentially a standard, all-glass mercury diffusion pumping system with the addition of a feedback line connected between the fore-vacuum manifold and the high vacuum end. A mercury valve is used to cut the feed-back line off, so that normal evacuation may take place. When the line is open the gas in the fore-manifold is pumped back through the feed-back line by the diffusion pumps, establishing a pressure differential between the fore-manifold and high vacuum manifold which is determined by the pumping speed of the diffusion pumps and the impedance of the feed-back line.

3037 A Motor for Use in Vacuum Systems. C. P. Butler and F. E. Carpenter. Rev. Sci. Instruments 21, 103(1950) Jan. (Laboratory and shop note).

In problems where evaporation techniques are used there is often a need for a motor which can be operated inside the vacuum chamber. The most important requisite of any motor

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operated in a high vacuum system is that there shall be no outgassing from the coils, the armature or the bearings even at temperatures up to 100°C. This requirement precludes the use of any motor where insulated wire is exposed to the vacuum system. This requirement has been met by the use of a solid armature motor, whose field coils are hermetically sealed in a brass can. In operation the motor was mounted in the bell jar and bare copper wires from the base plate terminals were clipped to the motor leads. A variac was used to control its speed.

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3038 Studies on the Preparation of Zirconium Tetraiodide. W. Conard Fernelius and Benedict L. Vondra, Jr. NYOO-87, Dec. 8, 1949. 11p.

Various methods for the conversion of zirconium materials, likely to be obtained from a process for the separation of hafnium and zirconium, into the metallurgically desirable zirconium tetraiodide have been investigated. While some show promise, none are regarded as superior to the recently inaugurated commercial process (National Lead Company) involving the iodination of zirconium carbonitride. 11 references.

3039 Progress Report for October 1 - December 31, 1949. F. H. Norton, D. M. Fellows, M. Adams, M. McQuarrie, and C. P. Fullerton. NYOO-96, Dec. 31, 1949. 45p.

This report describes work carried out on the thermal conductivity problem, and the various possible methods of measurement are evaluated. A selected bibliography of 47 references on thermal conductivity measurements is appended. Appendix 2 discusses optical pyrometer readings when sighted down very small passages. Appendix 3 covers in detail the theory of the envelope type of thermal conductivity test. Appendix 4 reports the determination of thermal conductivities in low and intermediate temperature ranges for sintered $Al_2O_3$ and insulating firebrick.

3040 A Study of the Refractory Borides. Leo Brewer, Dwight L. Sawyer, D. H. Templeton, and Carol H. Dauben. UCRL-610, Feb. 24, 1950. 21p.

The phases of the boron systems of Ce, Ti, Zr, Nb, Ta, Mo, and W were determined by x-ray examination of various mixtures of boron and the respective metal after heating to elevated temperatures. The x-ray examination of the various preparations has indicated the following definite phases: $W_2B$, $WB_{0.92-1.02}$, $WB_{2.0-2.13}$, $Mo_2B$, $MoB_{0.96-1.06}$, $MoB_{2.33}$, $Ta_2B(?)$, $Ta_2B(?)$, TaB, $Ta_3B_4$, $TaB_{1.78-2.57}$, $Nb_3B(?)$, $Nb_2B(?)$, NbB, $NbB_{2\pm x}$, $ZrB_2$, $TiB_2$, $CeB_4$, and $CeB_6$. Data on the sintering behavior and stability at high temperatures of many of the phases were obtained. The molybdenum and tungsten borides were very high melting, but were not as stable toward reduction as the other borides. TaB and NbB appear to be the most promising refractory borides for highly reducing conditions. $ZrB_2$ and $CeB_4$ also show considerable promise. The tungsten borides, $W_2B$ and $WB_{0.92-1.02}$, should be useful refractories when reducing conditions are not so severe. The molybdenum borides appear to be very similar in behavior to the tungsten borides except for somewhat lower melting points, which may be an advantage under some circumstances because of the difficulty in sintering tungsten borides except at very high temperatures. 15 references.

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3041 Elevated-Temperature Properties of Several Titanium Carbide-Base Ceramals. G. C. Deutsch, Andrew J. Repko, and Wm. G. Lidman. Natl. Advisory Comm. Aeronautics, Tech Note 1915, (1949). 47p.

Materials consisting of combinations of metals and ceramics were investigated for the production of parts which would stand up under the severe high temperature conditions encountered in turbine-type aircraft engines. Because of its high strength at elevated temperatures and high resistance to thermal shock, TiC was chosen as the ceramic constituent. Cobalt was chosen as a bonding agent along with molybdenum and tungsten. The highest strengths as determined by modulus-of-rupture tests were shown by the following alloys: (1) 80% TiC, 20% Co; its strength at 1600°F was 57,800 to 100,800 psi; at 2,000°F the strength was 29,400 to 71,000 psi. (2) 90% TiC, 10% Mo; at 2400°F the strength was 16,100 to 20,000 psi.

3042 Physical Properties at Elevated Temperature of Seven Hot-Pressed Ceramic Materials. James J. Gangler, Chester F. Robards, and James E. McNutt. Natl. Advisory Comm. Aeronautics, Tech. Note 1911, (1949). 33p.

Seven hot-pressed ceramic materials were examined for possible use in gas-turbines and jet-engines. They are: MgO, TiC, $ZrC_2$, $B_4C$, 85% SiC + 15% $B_4C$, Zircon, and $ZrO_2$ stabilized with 6% CaO. The properties of these materials were studied at temperatures ranging from 1800 to 2400°F. $ZrC_2$ exhibited the best short-time tensile strength, although it oxidized easily. It was 15,850 psi at 2200°F. $B_4C$ had a short-time tensile strength of 22,550 psi at 1800°F. TiC was the most promising of all the samples tested and exhibited the best resistance to thermal shock. Its short-time strength at 2200°F was 9400 psi and 15,850 psi at 1800°F.

3043 Survey of the Demands on Heat Resistant Metals and Today's Possible Solutions. F. Rapatz. Arch. Metallkunde 3, 387-93(1949) Nov. (in German).

A summary of the properties of ferrous and nonferrous alloys at elevated temperatures is presented. The report was prepared from a survey of the literature.

3044 Titanate Ceramics for Electromechanical Purposes. Hans Jaffe. Ind. Eng. Chem. 42, 264-8(1950) Feb.

A development of technical importance is the electromechanical effect that is exhibited by barium titanate ceramic under the influence of a high electric polarizing field. Polarized polycrystalline barium titanate shows certain striking analogies to ferromagnetic materials, and it also exhibits properties usually associated with piezoelectric single crystals. The outstanding piezoelectric effects in barium titanate ceramic are the development of alternating electric charges when an alternating stress is applied parallel to the direction of polarization, and conversely, expansion and contraction in the direction of an electric alternating current field superimposed parallel to the prepolarization. This latter effect is especially useful for the production of ultrasonic waves in liquids. The ceramic can be shaped into large plates, spherical radiators, and the like, which would be costly to build from piezoelectric crystals such as quartz. Introduction of titanate ceramic radiators into the ultrasonic field may revolutionize the application of ultrasonic radiation to chemical processes involving interaction between solids and liquids or solids and gases. (auth)

3045 Titanium Investigations: Research and Development Work on the Preparation of Titanium Chloride and Oxide from Titanium Mattes. R. G. Knickerbocker, C. H. Gorski, H. Kenworthy, and A. G. Starliper. J. Metals 1, 785-91(1949) Nov.

Laboratory research indicates that it is possible to produce titanium tetrachloride and titanium oxide from rutile. This is done by smelting the rutile with pyrite and coke and then processing the titanium matte. An impure iron is recovered as a by-product. Recoveries of from 65 to 81% of the titanium in rutile may be obtained as an impure titanium tetrachloride by chlorinating titanium mattes at 150 to 250°C. When titanium matte is baked with sulfuric acid at 200 to 250°C, recoveries of 90% or more of the titanium in the rutile are obtained in the form of a titanium sulfate solution which is suitable for the recovery of pigment-grade titanium dioxide. Chlorinating the mattes, followed by baking the residues with sulfuric acid gave titanium recoveries greater than 90%.

3046 Titanium Tetraiodide. Preparation and Refining. Warren B. Blumenthal and Howard Smith. Ind. Eng. Chem. 42, 249-51(1950) Feb.

The history of titanium tetraiodide is reviewed and a new method for its preparation described. The preparation described is based on the reaction of economically prepared titanium-bearing alloys with iodine in carbon disulfide solution. A titanium-aluminum alloy, for example, yields titanium and aluminum iodides. By mixing these iodides with potassium iodide and heating, aluminum iodide is fixed as stable potassium iodoaluminate, and pure titanium tetraiodide distills over. The procedure has value for qualitative detection of titanium metal and should be adaptable to quantitative determination of metallic titanium. (auth)

3047 The Construction of the Geological Time-Scale. Arthur Holmes. Trans. Geol. Soc. Glasgow 21, 117-52(1947).

The problems involved in making a geological time scale are summarized, and tabulations of previous estimates by various methods are given. The determination of geologic time by the uranium-lead ratio method is discussed in detail, and a time scale for North America and the world is constructed by this method. Geological implications, particularly the sediment accumulation in geosynclines, are considered. A bibliography is appended.

3048 Determination of the Age of Minerals by Means of the Radioactivity of Rubidium. L. H. Ahrens. Nature 157, 269(1946).

The Rb/Sr ratios of five samples of lepidolite and one sample of pollucite were determined spectrochemically. Comparison with a prepared standard indicated ages ranging from 900,000,000 to 1,330,000,000 years.

3049 An Estimate of the Age of the Earth. Arthur Holmes. Nature 157, 680-84(1946); 159, 127-28(1947).

Calculations based on the relative abundance of lead isotopes in common lead minerals of various geological ages indicate that the age of the earth, reckoned from the time radiogenic lead first began to accumulate, is of the order of 3,000 million years. Later work indicates a revision to 3,350 million years. The discussion is concerned with the time at which the "age" is considered to start, and Holmes definitely states that the age which has been determined is that of the material containing the dispersed lead. This represents the elapsed time since the separation of the granitic layer from average earth material.

3050 Evolution of Th and $Pb^{208}$. Juan Manuel Lopez de Azcona. Anales real soc. espan. fis. quim. 45A, 181-3(1949) Mar.-Apr. (in Spanish).

The author compares the relative abundance of Th and $Pb^{208}$ at the time the earth's crust was formed with that of today. If D was the original ratio of Th in the substratum to that in the crust, and if A was the similar ratio for Pb, he finds D = 11.0 A + 10.0. The limiting values of Pb/Th in the substratum are then, for A = 0, Pb/Th = 0 at the time of crust formation and 0.23 today and, for A = ∞, Pb/Th = 0.12 at the time of crust formation and 0.34 today.

3051 Monazite from Bodmin Moor. A Study in Geochronology. II. Analysis of Bodmin Moor Monazite for Lead-Thorium and Uranium. A. A. Smales. Proc. Roy. Soc. Edinburgh 63, 125-29(1948).

Describes the method of microanalysis and the polarographic determinations made for lead, thorium, and uranium in detrital monazite from Bodmin moor, Cornwall, southwest England, in connection with determinations of apparent age.

3052 New Observations on the Inclusions of Pleochroic Haloes. E. Corin. Bull. soc. belge geol. 50, 48-61 (1942)(in French).

The pleochroic haloes of inclusions in chlorite schists of Remagne and amphibolites of Libramont are due to uranium, whereas those of the tonalities of the Hautes-Fagnes region, Belgium, are due to thorium. The products of modification of chlorite and amphibole nuclei by the alpha radioactive particles exhibit the same color, pleochroism, birefringence, and optical orientation, irrespective of differences in primary mineral composition.

3053 New Radioactive Source in the Bomba Spring at Barreiro-Araxá, Minas. Willer Florencio. Anais acad. brasil. cienc. 19, 315-19(1949), Inst. Tec. Ind. Minas Gerais, Avulso 7(1948). 12p. (in Portuguese).

The results of measurements to determine the radioactivity of the waters of the Bomba spring at Barreiro, near Araxá, Minas Gerais, Brazil, are presented.

3054 Present Status of Absolute Age Measurements in Brazil. J. P. Marble. Natl. Res. Council, Div. Geog. Geog., Comm. Measurement Geol. Time. Rept. 1948-49, Exhibit C, 68-74(1949).

Reports published data and supplementary analytical work on radioactive material from Brazil, and in particular from three localities—uraninite from Boqueira and Xique-Zique Rio Grando do Norte, and monazite from Santa Cruz. A table of approximate ages of radioactive minerals from several Brazilian localities is included.

3055 Report to Committee on the Measurement of Geologic Time. Arthur Holmes. Natl. Res. Council, Div. Geol. Geog. Comm. Measurement Geol. Time. Rept. 1947-48, Exhibit A, 16-20(1949).

Reports Pb/U/Th analyses of uraninite from Morogoro, Tanganyika, and of uraninite and monazite from post Delhi pegmatites of the Aravalli belt in India.

3056 Some Major Structures of the Canadian Shield. J. Tuzo Wilson. Can. Mining Met. Bull. 42, 543-54 (9149); Trans. Can. Inst. Mining Met. 52, 231-42 (1949).

A division of part of the Canadian Shield into provinces believed to represent former mountain belts is attempted, special emphasis being laid upon radioactive age determinations, the relation of Archaean to Proterozoic rocks, and the structure of the Grenville province. Original data on the distribution of radioactivity within several batholiths and their connection with ore deposits are presented. (auth)

3057 Research Creep of Alloys; Technical Progress Report; November 1, 1949, to January 31, 1950. E. R. Parker and T. H. Hazlett. COO-9, Feb. 1950. 5p.

The status of the nickel test program is covered, with partic ular emphasis on specimen preparation and results of activation energy studies. Brief mention is made of the programs for single crystal studies, theoretical development, and future work.

3058 An Absolute Measurement of the Copper-Copper Interfacial Energy. G. W. Sears. GEPM-19, Mar. 1950. 21p.

In the boundaries between the grains and phases that make up a metal there are tensions, just as there are tensions in the surfaces of liquids. The magnitudes of these interfacial tensions determine how fast and at what temperatures transformations such as grain growth, age hardening, and the decomposition of austenite, will occur. To calculate theoretically the kinetics of such transformations, the absolute values of these interfacial tensions are necessary. This report describes the first successful measurement of the tension in an interface between two solids. From measurements on forty lead drops and statistical treatment of the data obtained, a preliminary value of 380 ergs/cm$^2$ has been determined for the interfacial tension, copper(solid)-copper (solid).

3059 Interfacial Free Energy of the Coherent Boundaries of Annealing Twins in Copper. Robert L. Fullman. GEPM-20, Mar. 1950. 14p.

The ratio of the interfacial free energy of a twin boundary to that of a grain boundary in copper has been measured, assuming the influence of variation of grain boundary free energy with boundary orientation to be negligible. The result found is R = 0.045 ± 0.003. On the basis of Sears' (GEPM-19) preliminary measurement of the grain boundary free energy in copper, it is estimated that the twin boundary free energy in copper is about 17 ergs cm$^{-2}$. 13 references. (auth)

3060 Fundamental Research in Physical Metallurgy; Fifth Quarterly Report (Progress Report Number 19). J. H. Hollomon and D. Turnbull. GEPM-21, Apr. 5, 1950. 16p.

The grain boundary self-diffusion coefficient of silver as a function of temperature has been evaluated from diffusion data on polycrystalline silver at low temperature obtained by the sectioning technique. It is found that the activation energy for grain boundary diffusion is roughly half that for volume diffusion, in good agreement with earlier results obtained from the surface counting technique. Attempts are being made to determine activity coefficients in the copper-silver system by use of the copper-hydrogen sulfide equilibrium. The grain boundary free energy of adjacent copper crystals randomly oriented with respect to one another has been measured and found to be 380 ergs/cm$^2$ at 800°. The free energy of twin boundaries was found to be about 17 ergs/cm$^2$. (auth)

3061 Development of Zirconium Base Alloys; Fifth Quarterly Report (Progress Report Number 6). J. W. Pugh. GEZR-6, Apr. 5, 1950. 13p.

Casting apparatus which will make refractory alloys as large ingots either of constant or gradient composition has been constructed and preliminary tests made on it. Some mechanical tests were made on arc-cast zirconium and six zirconium-chromium alloys were made, machined to tensile test bars, and heat treated. (auth)

3062 The Application of Chemical Thermodynamics to the Study of Metallic Alloy Formation; Progress Report for October 1, 1949, to January 1, 1950. W. E. Wallace, et. al. NYOO-100, Jan. 3, 1950. 10p.

Heats of reaction of a number of samples of pure sodium and potassium with water have been measured. The results are somewhat suspect due to discrepancies, amounting to about 0.3%, between the masses of samples as determined (a) by weighing and (b) by titration. The source of the difficulty is currently under investigation. Unexpectedly large heats of deposition of platinum from chloroplatinic acid solutions suggested a possible simultaneous reduction of platinic ion to platinous ion. This has been confirmed. To confine this side reaction involving the deposition of platinum used in connection with heat of formation studies of magnesium-cadmium to just two valence states, 2 and 0, chloroplatinous solutions are being used as an accelerator. At present the heat of deposition of platinum from chloroplatinous acid is being determined. A solvent of RbBr and LiBr, liquid down to about 270°C, is being used in the electrolytic cell which is currently being employed to study the free energies of magnesium-cadmium alloys. Present indications are that diffusion in magnesium-cadmium alloys is sufficiently rapid around 270 to 300°C to allow these alloys to be used as electrodes in reversibly operating cells. Two alloys, one magnesium rich and one cadmium rich, have indicated very normal cell behavior. Modification of the conventional adiabatic shielding arrangement used in low temperature adiabatic specific heat calorimetry, necessitated so that the Collins Helium Cryostat can be employed, have been completed. Three platinum resistance thermometers have been compared between 10 and 90°K with a fourth thermometer bearing a Bureau of Standards certificate. An adequate low temperature scale is now available for the laboratory. (auth)

3063 Heats of Formation of Intermetallic Compounds. Raleigh L. McKisson and Leroy A. Bromley. UCRL-578, Jan. 31, 1950. 48p.

The heats of formation of intermetallic compounds as found in the literature have been tabulated. The values are listed for

each compound in kcal/g mole and kcal/g atom. The probable best value in each case is also listed. A short discussion of the relationship between values of the heats of formation in a given system of several compounds is given. An equation is derived and applied to the sodium-tin and sodium-mercury systems. This equation will allow a calculation of the heats of formation of peritectic melting compounds and in some cases congruent melting compounds, provided the phase diagram and one heat of formation in the system is known. 37 references. (auth)

3064 Determination of Green Strength by the Transverse Rupture Test. J. P. Scanlan and R. P. Seelig. Powder Met. Bull. 4, 128-32(1949) Sept.

An apparatus is shown and described for determining the effect of metal powder characteristics on the green and sintered properties of metal compacts. The transverse rupture test responds strongly to the difference in green strength between iron and copper powder compacts. It also shows the detrimental effect of the 1% lubricant addition to the powder mixture. This effect is greater in the case of copper than in the case of iron. On the other hand, the density is increased by the lubricant addition. Relative values obtained under identical testing conditions give a reliable indication of the bonding strength of metal powder compacts. These values can be used as evaluation of different powders, mixtures, pressures, and pressing conditions.

3065 Effect of Carbon in Titanium Metal Ingots. E. A. Gee, J. B. Sutton, and W. J. Barth. Ind. Eng. Chem. 42, 243-9(1950) Feb.

To answer numerous questions concerning the effect of carbon on commercially pure titanium, titanium ingots containing 0 to 1.5% carbon have been forged and rolled. It is apparent that ingots, in which carbon varies between these extremes, can be forged readily at a furnace temperature of 1,700°F. All metal was rolled at a furnace temperature of 1,450°F without extensive surface or edge checking, excepting the highest carbon ingot. No edge cracking occurred when the metal was subsequently cold reduced 25%. Ultimate tensile strength, yield strength, elongation, bend ductility, and hardness are reported. It is concluded that carbon up to 1.2% has little effect on forgeability and rollability if suitable operating conditions are imposed. Results indicate that increasing amounts of carbon above 0.25% do not appreciably affect strength but do decrease ductility. (auth)

3066 Fabrication of Titanium-Rich Alloys. Mechanical Properties of Some Wrought Alloys. E. I. Larsen, E. F. Swazy, L. S. Busch, and R. H. Freyer. Ind. Eng. Chem. 42, 237-42(1950) Feb.

The authors present the melting procedure and a discussion of a furnace used for the production of small (1 to 2 lb) titanium and titanium alloy ingots. The fabrication of the billets into specimens suitable for the determination of tensile strength, elongation, resistance to oxidation, hardness at elevated temperatures, and resistivity is also discussed. Melting and casting were done in graphite in an inert atmosphere. After a slight surface scalping, the ingots were hot forged to 0.5- to 0.625-in.$^2$ rods from which appropriate test specimens were machined. Alloys containing up to 5% iron, cobalt,

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nickel, chromium, molybdenum, manganese, vanadium, copper, indium, silicon, boron, aluminum, manganese-silicon, manganese-aluminum, and aluminum-chromium have been made. Of the alloys investigated to date, those containing boron, vanadium, tungsten, iron, manganese-silicon, and aluminum-chromium appear to have the highest mechanical properties. The following values are typical of those obtainable with this group of binary or ternary alloys: ultimate tensile strength, 150,000 to 180,000 psi; proportional limit, 90,000 to 105,000 psi; yield strength (0.2% offset), 120,000 to 145,000 psi; modulus of elasticity, 16.6 to 17.8 $\times 10^6$ psi; and elongation in 2 in., 2.5 to 13%. The mechanical properties of titanium containing from 0.3 to 1.9% carbon are given. (auth)

3067 Frequency Factor and Activation Energy for the Volume Diffusion of Metals. G. J. Dienes. AECU-740, Mar. 9, 1950. 15p.

The theoretical equations proposed for calculating $D_0$ of the diffusion-constant-temperature relation, $D = D_0\ e^{-E/RT}$, are critically discussed in the light of presently available data. It is concluded that none of the relations gives satisfactory agreement with experiment. Empirical analysis of experimental data covering a wide range of $D_0$ and E values showed that the quantity $E/T_m$, where $T_m$ is the melting point in °K, is the main factor in determining the value of $D_0$, and that $D_0$ depends approximately exponentially on $E/T_m$. In addition to many other diffusion constants, it is shown that the anisotropic diffusion of zinc and the widely differing diffusion constants for self-diffusion in $\alpha$- and $\gamma$-iron are included in the proposed empirical correlation. A possible theoretical basis for the empirical correlation is described based on the idea of local melting or disordering. The quantity $E/T_m$ is identified with the entropy of activation. 18 references. (auth)

3068 Kinetics of the Oxidation of Titanium. W. A. Alexander and L. M. Pidgeon. Can. J. Research 28B, 60-72(1950) Feb.

The rates of oxidation of titanium powder and sintered bar have been investigated in the temperature range 25° to 550°C at pressures of 2 and 20 cm oxygen maintained constant throughout each experiment. It has been shown that the oxidation process can be divided into two mechanisms, viz., the formation of a thin surface film and diffusion of oxide into the metal. The surface film formation at low temperatures follows the logarithmic equation:

$$\ln(t + 3) = k_1 V + k_2$$

on vacuum annealed metal surface. The diffusion process at higher temperatures is described by the equation:

$$\log \frac{C - C_f}{C_i - C_f} = -\text{const} - 2.3\,\frac{t}{\tau}$$

after the initial oxidation. This equation leads to preliminary values of the diffusion constant of the order of $10 \times 10^{-8}$ cm$^2$/min in the temperature range 463° to 565°C. (auth)

3069 Magnesium Industry in the Soviet Zone of Germany. The Metal Bull. 3462, 16(1950) Jan. 17.

The old German electrolytic magnesium plant at Bitterfeld (Soviet Zone of Germany) was altered after the war to produce 1,200 tons of Calcium metal monthly. The output is des-

patched to a plant in Russia about 60 miles from Moscow in connection with atomic development.

3070 Mechanical Properties, Weldability, and Corrosion of Commercially Pure Titanium. N. Adenstedt. U. S. Air Force Report No. AF-TR-5935, Oct. 1949. 51p. (See also NSA 4-465.)

Annealed and cold rolled commercially pure titanium have been tested by laboratory methods. The mechanical properties were satisfactory and in agreement with previous investigations. The cold rolled material showed a lower compression yield strength in longitudinal than in transverse direction. The endurance limit of the cold rolled titanium was low due to surface defects; it could be increased by surface grinding. Titanium showed a better corrosion behavior than stainless steel when in contact with aluminum and magnesium alloy. Creep was observed to occur at room temperature when titanium was loaded near to its yield strength. The creep was more pronounced in the annealed than in the cold rolled condition. At 800°F the stress rupture values are good. Titanium is weldable by the shielded arc and spotwelding methods. Normal spotwelders can be used. (auth)

3071 On the Initiation of Reactions Between Solid Phases. A. Smekal. Powder Met. Bull. 4, 120-6(1949) Sept.

It is demonstrated that the first mechanical contact between two particles takes place over areas which, from molecular dimensions up to diameters of the order of 1 micron, permit the utilization of the full strength of the chemical bonding forces. When the critical resistivity values are reached, the building elements of the solid are mobilized and thus become highly reactive. This transitory stage of high reactivity leads locally, depending on the chemical nature and the homogeneous or heterogeneous character of the involved components, to chemical reactions, alloy formation, and bonding by fusion. Such processes limited to contact areas are invariably accompanied by the liberation of heat in the order of magnitude of the heats of fusion. It is, therefore, not justified to treat these processes as reactions taking place entirely in the solid state. To initiate such processes, the small loads involved in the packing or mixing of loose powders are shown to be fully sufficient. These loads, therefore, promote the initiation of chemical reactions between solids as well as that of sintering processes. (auth)

3072 Optical Metallography of Titanium. Walter L. Finlay, John Resketo, and Milton B. Vordahl. Ind. Eng. Chem. 42, 218-22(1950) Feb.

The special characteristics of titanium which are of controlling importance in its optical metallography are that titanium undergoes an allotropic transformation at 885°C, it possesses great reactivity at elevated temperatures, and it deforms at room temperature both by slip and by twinning. Photomicrographs illustrate the effects of these characteristics. Metallographic techniques which have been developed are outlined and typical microstructures of commercially pure unalloyed titanium in a variety of metallurgical conditions are presented and discussed. Interesting structures obtained with titanium-base alloys are presented to show the applicability of the metallographic technique to a wide range of titanium-base structures. (auth)

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3073 Preparation and Properties of the Titanium-Base Alloys. P. H. Brace, W. J. Hurford, and T. H. Gray. Ind. Eng. Chem. 42, 227-36(1950) Feb.

The authors present the chief results of an investigation of the preparation and of the mechanical properties of a number of titanium-base alloys, with particular reference to their behavior in cast form at high temperatures. The alloys were prepared by melting and casting in vacuum or under an atmosphere of highly purified argon in a specially constructed furnace system which, by rotation about a horizontal axis, transferred the metal from the inductively heated melting chamber to a mold that was preheated by means of an electrical resistance unit. Experiences with the various refractories are outlined with particular reference to reaction between the melts and the refractories and the wetting of the latter by the molten alloys. Thorium oxide was the material of choice for crucibles. Various materials were used for molds including graphite, alumina, and magnesium oxide. The design and manufacture of molds for producing cast specimens for tensile test are described. Quantitative tensile data for as-cast specimens are given for tests by constant strain rate and creep-rupture methods at several elevated temperatures and some information is given concerning oxidation characteristics. Alloys containing more than 95% titanium were found that exhibited suprisingly good resistance to oxidation in air up to approximately 900°C. Among the more highly alloyed compositions the stronger showed yield strengths at 950°C comparable to those of such high-temperature alloys as No. 31 Stellite; because of the relatively low density of the titanium alloys, the ratios of yield-strength to weight were in some cases favorable. Many of the stronger alloys were brittle at room temperature, a disadvantageous characteristic. (auth)

3074 The Present Status of Titanium Metal. Felix B. Litton. J. Electrochem. Soc. 97, 66C-68C(1950) Mar.

The author describes the Kroll and iodide processes for the production of titanium metal from pure titanium dioxide and presents the physical properties of the relatively pure metal. The mechanical properties of titanium produced by the iodide and magnesium reduced processes are given and a discussion of the melting techniques, miscellaneous properties, and some titanium alloys is included.

3075 Rapid Determination of Susceptibility of Aluminum Alloys to Intercrystalline Corrosion. Hugh L. Logan. Metal Progress 57, 211(1950) Feb. (correspondence).

A new rapid procedure is described for determining the susceptibility of aluminum alloys to intercrystalline corrosion. The time is reduced to 30 min or less by an electrolytic procedure. The specimen to be tested is made the anode in a normal NaCl solution and the current density is adjusted between 0.5 to 2 amp/in.$^2$ of surface of the sample tested. The specimen is checked microscopically as described in Army-Navy Aeronautical Specification AN-QQ-H-186a. Three photomicrographs are included.

3076 Recent Developments in Titanium. E. A. Gee, W. H. Van Derhoef, and C. H. Winter, Jr. Electrochem. Soc. J. 97, 49-53(1950) Feb.

The purity of ductile titanium has exceeded 99.5% since the commercial production of the metal got under way over a year ago. Present production is based upon reduction of titanium halides with active metals such as magnesium. Products of the reaction may be separated by leaching or vacuum distillation yielding powder and sponge titanium, respectively. Sponge or powder metal may be consolidated by melting under an inert atmosphere in graphite with no particular difficulty. Approximately 0.5 to 1.0% carbon is dissolved in the cast metal, and ingots of 100 lb (45 kg) and larger have been produced.

3077 Supplement to "Powder Metallurgy—Its Physics and Production." Part III. Theoretical Concepts. Paul Schwarzkopf. Powder Met. Bull. 5, 4-14(1950) Jan.-Mar.

A review is given of the theoretical concepts presented during the past few years regarding the sintering of powder metal compacts. The contributions which are merely extensions of older theories are first discussed followed by the fundamentally new approaches to the sintering problem. The theories of Hedvall, Hütlig, Kingston, Schwarzkopf, Balshin, Dawihl, May, Shaler, Kuczynski, Herring, and others are described. 61 references.

3078 Titanium Alloys. Bruce W. Gonser. Ind. Eng. Chem. 42, 222-6(1950) Feb.

The favorable atomic size of titanium and its other fundamental properties favor alloying with nearly all the useful metals. Practically, the relatively high melting point of 1,725°C discourages alloying with those metals having high volatilization rates below this temperature. Reaction of titanium with nitrogen, oxygen, and carbon is of great importance, not only in raising difficulties in handling, but in profoundly affecting the mechanical properties by forming interstitial solid solution alloys. A transformation point at 885°C for the pure metal may be drastically reduced or raised by alloying additions. This transformation in some alloys makes possible considerable strengthening, by heat treatment, and small grain size, by retaining some of the $\beta$ constituent on cooling. A large field of useful alloys is indicated and is being explored rapidly. Among the most useful are combinations of metal additions, particularly those having considerable solid solubility in either of the allotropic forms of titanium, plus small amounts of carbon, oxygen, or nitrogen. (auth)

3079 Uranium as a Metallographic Aid. E. H. Rowe. Metal Progress 57, 336(1950) Mar. (correspondence).

Uranium has been substituted for chromium in electron microscope work for "shadow casting." In this technique a very thin metal layer is desirable in order to keep the distortion to a minimum. The high atomic number and great density of uranium has been found to be the best material for this job.

3080 Analysis of Ore Residues for Ionium and Protactinium. L. I. Katzin, Q. Van Winkle, and J. Sedlet. AECD-2811, Dec. 2, 1946, Decl. Mar. 28, 1950. 10p.

This report deals with analysis of some pitchblende ore residue fractions which have not previously been considered as sources for protactinium ($Pa^{231}$) and ionium ($Th^{230}$), but

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which are found to be convenient sources of these materials. A brief discussion of the ore processing for uranium is given, with the possible sources of these isotopes described. The analytical results are summarized.

3081 Canadian Deposits of Uranium and Thorium. W. F. James, A. H. Lang, Richard Murphy, and S. N. Kesten. Mining Eng. 187, 239-55(1950) Feb.

The authors give a summary of information on Canadian deposits of uranium and thorium up to the end of 1948, prepared by geologists of Eldorado Mining and Refining, Ltd., and by the specialist on uranium deposits for the Geological Survey of Canada. A history of Canadian uranium and thorium discoveries, a working classification of the deposits, fairly detailed descriptions of the Eldorado mine and of properties in northern Saskatchewan, and shorter accounts of several other discoveries are presented.

3082 Carnotite and Radioactive Shale in Missouri. G. A. Muilenberg and W. D. Keller. Earth Sci. Dig. 4, 24(1950) Mar.

A deposit of carnotite and an unidentified radioactivity in black shale have been found in a limestone quarry near Ste. Genevieve, Missouri.

3083 Characteristics of Marine Uranium-bearing Sedimentary Rocks. V. E. McKelvey and John M. Nelson. Econ. Geol. 45, 35-53(1950) Jan.-Feb.

This is a summary, by the U. S. Geological Survey, of general information on the occurrence of uranium in marine shales and phosphorite formations. Such deposits are large but low grade, but inasmuch as other countries, namely Sweden and possibly Russia, are now recovering uranium from them it behooves us to investigate this source. Marine deposition of uranium was favored in certain geological periods and rocks of the appropriate ages occur in most parts of the United States.

3084 Chemical Analyses of Japanese Minerals. II. Zyunpei Harada. J. Faculty Sci. Hokkaido Imp. Univ. [4] 7, 143-210(1948).

A ten-year supplement to an earlier report on the results of chemical analyses of Japanese minerals.

3085 Contribution to the Knowledge of the Radioactivity of Metalliferous Deposits in Sardinia. G. Frongia. Rend. seminar. facolta sci. univ. Cagliari, 9, (1939) (in Italian). 19p.

The results of measurements of the radioactivity of metalliferous deposits of Sardinia, Italy, are tabulated. The radioactivity of the ores and the enclosing rocks is nominal. Granite exhibited the greatest activity.

3086 Determination of the Uranium Content in Rocks. Geochemical Studies. Part I. H. Erlenmeyer, W. Oppliger, K. Stier, and M. Blumer. Helv. Chim. Acta 33, 25-36(1949)(in German).

A colorimetric determination of uranium is based on the fluorescence in ultraviolet light exhibited by U-containing beads of fused NaF. The method was systematically studied with the view of its applications to rock analysis, and the results showed that quantitative determinations of $10^{-6}$ g U with a ±5% error are possible. A U-containing solution,

evaporated to a small volume (2 to 5 cm³), is mixed with one g NaF into a mass that is then calcined and ground into a powder, from which, with the aid of a Pt loop, fused beads are prepared. The main problem was, first, the determination of the degree of weakening of the fluorescence, which is caused by many of the elements present in a rock sample, and, secondly, the finding of a simple general method for the removal of the disturbing elements. The sample is either directly dissolved in hot concentrated HCl (basic rocks), or it is previously calcined with $Na_2CO_3$, then dissolved in HCl (acid rocks). The solution is then treated, successively, (1) with $NH_3$, whereby U is carried over in the $Fe(OH)_3$ precipitate, (2) with diluted HCl for dissolving, and (3) with $(NH_4)_2CO_3$ in order to separate U (which remains in the solution) from Fe. The solution, now free from disturbing admixtures, serves for the preparation of NaF beads, as shown above. Results of U determinations in many rocks (chiefly from the Alps) such as bituminous rocks, iron ores, bauxites, and pegmatites, and in river water are given.

3087 Mineral Supplies for Atomic Energy. Cyril S. Fox. Mining J. 234, 310-12(1950) Mar. 31.

In a preliminary discussion the author describes the process of fission and discusses the materials required. Geological considerations are presented along with information regarding the occurrences of thorium and uranium deposits. The chief sources of uranium ore are the Belgian Congo, the Great Bear Lake in Canada, the Erzgebirge in Bohemia, and the low grade carnotite ore in Colorado, and possibly a deposit in Siberia. The monazite sands of Travancore are the most useful source of thoria today. The world's supply of uranium is somewhat under 10,000 tons of ore annually and thorium approximately 5,000 tons of suitable monazite sand.

3088 Monazite from Bodmin Moor, Cornwall. A Study in Geochronology. I. Monazite as a Geological Timekeeper. Arthur Holmes. Proc. Roy. Soc. Edinburgh 63, 115-24(1948).

Detrital monazite from the granite of Bodmin moor, Cornwall, England, has been analyzed for lead, uranium, and thorium for geologic age determination. An apparent age of 290 million years in considered due to both the presence of original lead and partial loss of uranium. The absolute age is 215 million years, or late Carboniferous. Data on monazite from Mt. Isa, Queensland, and Las Vegas, New Mexico, are included.

3089 Note on the Uranocircite from Vinaninkarena (Madagascar).. J. Behier. Madagascar, Bull. Bur. Geol., f. 1, 3-8(1949)(in French).

Describes the physical, chemical, and optical properties of uranocircite from Vinaninkarena, Madagascar, and discusses the occurrence and possible origin of the mineral. It occurs principally in nodules in a sandy clay. It may have been formed either by alteration of primary betafite or pitchblende contained in the parent rock from which the enclosing clay was derived, or it may be the product of precipitation from radioactive thermal waters.

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3090 The Oldest Known Minerals and Rocks. Arthur Holmes. Trans. Roy. Soc. Edinburgh 14, 176-94 (1948).

Discusses the lead method of determining the age of rocks containing uranium and thorium, with particular attention to the studies made on uraninites from Karelia (USSR), Arendal (Norway), and the Canadian Shield (Ontario).

3091 Pitchblende, the Primary Source of Uranium. Phillip L. Merrit. In Conf. on Radioactive Ores (Michigan State Coll.), May 6, 1949, p.8-12. New York, Houghton, 1949.

Describes briefly the geology and mineralization of the three major pitchblende districts of the world—the Erzgebirge region of Saxony and Bohemia; Great Bear Lake, Canada; and Shinkolobwe, Belgian Congo. Selected references for each area are included.

3092 A Prospector's Handbook to Radioactive Mineral Deposits. C. F. Davidson. London, Gr. Brit. Geol. Surv., 1949. 28p.

Describes the common radioactive minerals, principal types of radioactive mineral deposits, and radioactivity testing methods as an aid to prospectors in the exploration for uranium and thorium ores.

3093 Radioactive Mineral Deposits. Notes for the Guidance of Prospectors in Australia. Australian Bur. Min. Res., Geol. and Geophys., Pam No. 3, 1948. 25p.

The properties of uranium- and thorium-bearing minerals are discussed, and typical occurrences described.

3094 Recognition of Uranium and Thorium Minerals in the Field. A. M. Heron. Indian Minerals 1, 245-7 (1947).

A brief description of uranium and thorium minerals, with notes on their identification in the field.

3095 Review of Work in Japan. John Putnam Marble. Natl. Res. Council, Div. Geol. Geog., Comm. Measurement Geol. Time, Rept. 1947-48, Exhibit C, 23-4 (1949).

Brief summary of Japanese publications between 1941 and 1945 concerning radium and thorium content of rocks and minerals, radioactive mineral occurrences, and measurement of geologic time.

3096 Sengierite. A Preliminary Description. J. F. Vaes. Am. Mineral 34, 109-20(1949).

A hydrous copper, uranium, vanadium mineral from Katanga, Belgian Congo, with the formula $2CuO\ 2UO_3\ V_2O_5\ 10H_2O$, is believed to be a new mineral and is called sengierite in honor of Edgard Sengier. X-ray diffraction, chemical analysis, spectrographic study, crystallographic measurement, and optical study combine to suggest that the material described in related to carnotite and tyuyamunite, but differs chemically in that it is a definite copper-bearing species. In crystallization it may be quite similar to the other two minerals. (auth)

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3097 Six New Uranium Minerals from Shinkolobwe. J. F. Vaes. Ann. soc. geol. Belg [A-6B] 70, B 212-25 (1947)(in French).

Describes six new uranium minerals from Shinkolobwe, Katanga, Belgian Congo—billietite, a hydrous uranate of barium which occurs as small tabular crystals; vandendriesscheite, a hydrous uranate of lead, which occurs in the form of pseudohexagonal crystals; masuyite, a hydrous uranate of lead, which is found in small geodes in pitchblende; richetite, a hydrous (?) uranate of lead, which occurs as small tabular masses embedded in uranophane needles; studtite, a hydrous uranium carbonate, which occurs as long thin fibers; dideriichite, a hydrous uranium carbonate, which occurs as fibrous crusts.

3098 Uraninite in Brazil. Willer Florencio. Inst. Tec. Ind. Minus Gerais, Avulso 4(1948). (in Portuguese). 24p.

An account of the occurrence and chemical composition of uraninite from several localities in Brazil. Chemical analyses are included.

3099 Uranium. Manuel Tellechea. Rev. Mus. Hist. Nat. Mendoza 1, 38-50(1947)(in Spanish).

A general account of uranium, with brief descriptions of some uranium minerals and notes on the uranium deposit of Mendoza, Argentina.

3100 Uranium in Pegmatites. Lincoln R. Page. Econ. Geol. 45, 12-34 (1950) Jan.-Feb.

A study of uranium minerals in domestic pegmatites has been carried out by the U. S. Geologic Survey. None of the known domestic deposits warrants mining for uranium alone and it will probably continue to be a by-product with no appreciable production expected from these sources. Known geological relationships are described which might serve as guides in finding new pegmatite deposits at least as commercially favorable as those Madagascar.

3101 Uranium-bearing Sandstone Deposits of the Colorado Plateau. R. P. Fischer. Econ. Geol. 45, 1-11(1950) Jan.-Feb.

The uranium-bearing sandstone deposits of the Colorado Plateau, commonly referred to as "carnotite deposits," have a wide but spotty distribution. The deposits are irregularly tabular on lenticular but vary widely in size and grade of ore. The author describes geological formations and colorations which furnish clues in prospecting and outlines the long-range program of diamond-drill exploration being conducted by the Geological Survey on behalf of the Atomic Energy Commission.

3102 Uranium Deposits in the USSR. D. B. Shimkin. Science 109, 58-60(1949).

A summary of research and exploration of the uranium deposits in the USSR, with special reference to occurrences in Central Asia and the deposits associated with pegmatites in the region between Baikal lake and the Aldan gold fields.

3103 Uranium Minerals from Nellore District. C. Karunakaran and K. Neelakantam. J. Sci. and Indus. Res. Delhi [B.2] 5, 36(1946).

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The radium content of uranium minerals from the Nellore district, India, compares favorably with that of ores from Colorado and Katanga, Belgian Congo. Study of a radioactive mineral recently collected indicates that it is probably samarskite.

3104 The Warm Springs of Itau. Willer Florencio and Celso de Castro. Inst. Tec. Ind. Minas Gerais, Avulso 6(1948). 20p. (In Portuguese).

Describes three groups of warm springs between São Sebastião do Paraiso and Jacui, Minas Gerais, Brazil, locally called the Itau springs. They are classified as subthermal springs, with a mineral composition of bicarbonates of calcium, magnesium, and soda. The waters are feebly radioactive.

3105 Calculation of Diffusion Penetration Curves for Surface and Grain Boundary Diffusion. J. C. Fisher. GEPM-18, Jan. 1950. 13p.

Diffusion in solids is known to occur along grain boundaries and over free surfaces more rapidly than through the interiors of crystals. In order to facilitate quantitative investigation of grain boundary and surface diffusion, a mathematical analysis of the problem has been completed, assuming that grain boundary diffusion is analogous to the diffusion of heat along a thin copper foil imbedded in cork. The calculated diffusion-penetration relationship for grain boundary diffusion is shown to agree with the experimentally determined (by radioactive tracer) grain boundary self-diffusion of silver. (auth)

3106 Correlation of Geiger Counter and Hall Effect Measurements in Alloys Containing Germanium and Radioactive Antimony 124. G. L. Pearson, J. D. Struthers, and H. C. Theuerer. Phys. Rev. 77, 809-13(1950) Mar. 15.

The distribution of the solute atoms in ingots of germanium-antimony alloys which were prepared according to a prescribed cooling cycle have been measured. The solute was $Sb^{124}$ and its distribution was measured with a Geiger counter. In addition, Hall measurements were made which show that in the impurity saturation range each antimony atom contributes one conduction electron. This makes it possible to determine the solute distribution in nonradioactive samples by the Hall method. (auth)

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3107 The Composition of Our Universe. Harrison Brown. Phys. Today 3, 7-13(1950) Apr.

The author discusses the spectroscopic methods of determining the abundances of elements in the atmospheres of the stars and the planets. Figures are given for the abundances of various elements in the sun's atmosphere. It is believed that these figures also apply to the sun's interior, but the evidence is not conclusive. The hydrogen content may also be determined from the mean molecular weight as calculated from the mass, radius, and luminosity of the star, with the aid of widely accepted theories of stellar structure and radiation. Using such methods it has been found that hydrogen and helium constitute 99.8% of the matter in our part of the universe. Differences in composition of individ-

ual stars are discussed, and the abundances of elements in meteorites and in the different planets are also treated in some detail.

3108 The Production of Mesons by Photons. K. A. Brueckner. UCRL-597, Feb. 3, 1950. 41p.

The general features of the process of photomeson production are discussed on a semi-classical basis and also on the basis of perturbation theory in the weak coupling approximation applied to scaler, pseudoscalar, vector, and pseudovector meson theory. These calculations are carried out with the Feynman-Dyson methods to give covariant expressions for the cross sections. The corrections of next higher order in the meson-nucleon coupling are calculated for pseudoscalar mesons and shown to give large contributions. Comparison of the conclusions of the theory with the experimental results seems to indicate that the meson is of spin zero and closely bound to the nucleons as is characteristic of pseudoscalar theory. (auth)

3109 The Detection of Artificially Produced Photomesons with Counters. J. Steinberger and A. S. Bishop. UCRL-631, Mar. 8, 1950. 8p.

A counter technique, which depends on the decay electron for the identification of the meson, has been extensively used in cosmic ray research and has now, with some modifications, been applied to the photomesons produced by the synchrotron. When a positive $\pi$-meson comes to rest, it disintegrates very quickly into a $\mu$-meson, and this in turn into an electron. The range of the $\mu$-meson is such that when this process takes place in a scintillation crystal with linear dimensions of the order of several centimeters, a large fraction of the decay electrons will also appear in the crystal. The $\pi \rightarrow \mu$ decay is too rapid to be resolved in the electronics of the experiment; instead, the characteristic half-life of the $\mu \rightarrow e$ decay is used to identify the meson. The apparatus is described. With the usual synchrotron beam intensity of about $10^4$ ergs/sec the meson counting rate is about 15 cts/min. This makes it possible to do experiments more quickly than with photographic emulsions. On the other hand, so far only positive mesons can be counted in this manner, and absolute cross section measurements have a large error, since the detection efficiency is not known with precision.

3110 Preliminary Results on the Production of Mesons by Photons on Carbon and Hydrogen. J. Steinberger and and A. S. Bishop. UCRL-632, Mar. 8, 1950. 10p.

The method of meson detection described in a previous letter (UCRL-631) is being applied to the study of the production of positive mesons by $\gamma$ rays on hydrogen and heavier nuclei. Some preliminary results are reported in which the hydrogen cross sections are obtained by subtracting the the yield on carbon from those on paraffin. All the measurements reported here are being continued, and hydrogen cross section measurements with a liquid hydrogen target are in progress.

3111 Changes in Cosmic Ray Intensity Associated with Air Pressure, Height of the 100 mb Level and Magnetic Storms. B. Trumpy. Bergen Museums Arb., No. 3, 3-17(1949).



Continuous records of cosmic-ray intensity with a twofold counter telescope containing 8 mm Pb and shielded above with 80 cm Fe + concrete are described for the winter 1948-49 at Bergen, and these are correlated with meteorological conditions and with radio-sonde pressure records. Particular attention is directed to variations of intensity near warm and cold fronts which follows the height of the 100 mb layer closely rather than the air pressure, and limitations in the description of the pressure coefficient of variation of intensity are indicated. Observations of intensity variations associated with magnetic storms Jan. 24-27, 1949, are also described. (Taken in entirety from Science Abstracts 53A, 142(1950) Feb.)

3112 Cloud-Chamber Study of Cosmic Rays Underground. O. L. Tiffany and W. E. Hazen. Phys. Rev. 77, 849(1950) Mar. 15 (Letter to the editor).

A counter-controlled cloud chamber was operated in a salt mine at a depth of $8.6 \times 10^4$ g/cm$^2$ from the top of the atmosphere with the following primary objectives: to determine the character of the penetrating rays present at great depths, and to investigate the properties of the secondaries that the penetrating rays produce in the salt roof above the cloud chamber and in Pb, Al and brass absorbers in the cloud chamber. It was found that most of the penetrating particles at this depth are ionizing. These ionizing penetrating rays interact with matter in a manner that demonstrates qualitative resemblance with the penetrating rays at sea level. Since the average number of secondary electrons is higher and showers of electrons occur more frequently than at sea level, the average energy is apparently much higher.

3113 Cosmic Radiation and the Maintenance of a Potential Gradient in the Atmosphere. Robert E. Holzer. Phys. Rev. 77, 846(1950) Mar. 15 (Letter to the editor).

In a recent paper Korff (Phys. Rev. 77, 144(1950)) has suggested that cosmic radiation can maintain a potential gradient in the atmosphere, and that this mechanism is partly responsible for maintaining the potential gradient near the surface of the earth. The author believes that, although the suggested mechanism may be important in the higher atmosphere, this theory fails to account for electrical phenomena observed near the earth's surface. Measurements made at a large number of surface stations show that the potential in the atmosphere increases with height during fair weather, indicating a negative surface charge. The sign of the potential gradient and the atmospheric conduction current predicted by the proposed cosmic-ray mechanism is opposite to that observed near the surface. Further, as Korff has shown, the estimated cosmic-ray current is four orders of magnitude lower than the earth's discharging current.

3114 The Cosmic-Ray Intensity Above the Atmosphere at the Geomagnetic Equator. J. A. Van Allen and A. V. Gangnes. Phys. Rev. 78, 50-52(1950) Apr. 1.

By means of G-M Counter telescopes in an Aerobee sounding rocket fired from the USS Norton Sound, total charged particle cosmic-ray intensity above the atmosphere has been measured at the geomagnetic equator. An empirical zenith angle ($\theta$) dependence of directional intensity, averaged

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over all azimuths, is found to be $j(\theta) = 0.028(1 + 0.6 \sin \theta)$, in which $J(\theta)$ is in absolute units (sec cm steradian)$^{-1}$. The deduced vertical intensity 0.028/sec/cm$^2$/steradian is thought to be most nearly free of atmospheric albedo and, therefore, to be the best estimate of an upper limit for the primary intensity of charged particles of energy greater than 14 Bev (for protons). A comparison is made with previous results at geomagnetic latitude 41°N. (auth)

3115 Cosmic Rays and the Magnetic Field of the Sun. D. W. N. Dolbear and H. Elliot. Nature 165, 353-4 (1950) Mar. 4 (Letter to the editor).

The absence, even at great altitudes, of any increase in cosmic ray intensity with latitude at latitudes greater than 50 deg has been taken as an indication that the momentum spectrum of the primary radiation must be cut off at about $3 \times 10^9$ ev/c. Janossy (Z Physik 104, 430(1937)) has suggested that this cut-off in the momentum spectrum may be due to the sun's magnetic field, since this would be expected to set a limit to the momentum of particles which can approach the earth. In addition to this latitude cut-off there should also be a daily variation in the cosmic-ray intensity as the earth rotates relative to the directions which are forbidden by the solar field. The magnitude of this diurnal variation has been calculated and is compared with the observed variations. The discrepancies are significant and the authors conclude that the latitude cut-off cannot be attributed to the sun's magnetic field. The authors also point out that earlier data obtained by Millikan show no cut-off effect up to latitude 60°.

3116 The East-West Asymmetry of Positive and of Negative Mesons and the Excess of the Positives as a Function of Zenith Angle and Altitude. Gerhart Groetzinger and Gordon W. McClure. Phys. Rev. 77, 777-81(1950) Mar. 15.

The east-west asymmetry of positive and of negative mesons of energies around 800 Mev has been determined at altitudes of 260 and 4300 m at a geomagnetic latitude of 50°N for zenith angles of 24 and 58 deg. It is found that more positive mesons arrive from the west than from the east and more negative mesons arrive from the east than from the west, the asymmetries being equal but of opposite sign. From the magnitude of the asymmetries it can be concluded that the majority of the mesons observed under the above-mentioned conditions are produced in the top layer of the atmosphere. An increase of the positive excess for mesons of around 800 Mev is observed with an increase of the altitude from 260 to 4300 m. (auth)

3117 Heavy Fragment Disintegrations. P. E. Hodgson. Nature 165, 355(1950) Mar. 4 (Letter to the editor).

A star has been observed in Ilford G5 nuclear research emulsion exposed on the Jungfraujoch. It consists of three lightly ionizing particles and three singly charged particles emitted nearly in the same direction. The ranges of these particles, which all end in the emulsion, are 31 $\mu$, 61 $\mu$, and 88$\mu$, respectively, which is nearly in the ratio 1:2:3. The deviations from exact proportionality may be accounted for by straggling. These tracks are attributed to a triton, deuteron, and proton, respectively. The event may be explained by assuming that an excited lithium nucleus was ejected from

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a nucleus by a cosmic-ray particle and subsequently disintegrated in the following manner:

$$Li^6 \rightarrow H^1 + H^2 + H^3 - 21.3 \text{ Mev.}$$

This reaction is not the most favorable reaction energetically. However, if the spins of the disintegration products are all parallel, the total spin of the products is 2, whereas the alternative processes give products with spin 1. If the spin of the excited nucleus is 2, the other reactions will be forbidden. In another observed event, two tracks of singly charged particles with nearly equal range and in the same direction are observed. These tracks may be attributed to either of two reactions:

$$He^4 \rightarrow 2H^2 - 12.8 \text{ Mev.}$$

$$He^6 \rightarrow 2H^3 - 12.2 \text{ Mev.}$$

3118 The Lateral Distribution of Photons in Extensive Air Showers. G. Molière. Phys. Rev. 77, 715-16 (1950) March 1 (Letter to the editor).

The lateral structure of single cosmic-ray extensive air showers has recently been investigated by Cocconi et al. (Phys. Rev. 76, 1020(1949)) and independently by Amaldi and co-workers (Como Congress (Sept., 1949)). As far as the electron density, measured by unshielded G-M counters is concerned, both groups of experimenters found fairly good agreement with the theoretical results obtained by the author on the basis of cascade theory and coulomb scattering (Molière, Naturwissenschaften 30, 87(1942)). Amaldi in his experiments apart from unshielded counters also used lead shielded ones. His results in the latter case, where multiplication due to photons plays an important role, seemed strongly to contradict the author's theory. This conclusion had been drawn under the implicit assumption that the photon density will be roughly proportional to that of the electrons. The author has calculated the lateral distribution of photons in an intensive air shower. It may be seen from his result that the photon distribution differs greatly from the electron distribution, being more concentrated at the core of the shower, and exhibiting a more rapid variation near the core than would be expected from the behavior of the electron distribution. This type of distribution seems to agree qualitatively with the results of Amaldi. These considerations further suggest that the stars which occur with abnormally high frequency in the cores of cascade showers may be due to energetic photons and that processes of this kind may be the source of fast nucleons and of the weak meson component accompanying the extensive air showers.

3119 Measurement of High Altitude Vertical Cosmic Ray Intensity. G. S. Gokhale, A. S. Rao, and R. P. Thatte. Proc. Indian Acad. Sci. 30A, 184-204(1949) Oct.

Using the radio-sonde technique, three high altitude balloon flights were made at New Delhi 19°N (Mag.) to measure the total vertical intensity to heights up to 40,000 feet (200 mb). It has been found that the intensity versus pressure curve for the total intensity as reported by other workers is well represented by a third degree polynomial of the log (intensity) against log (pressure). There is good agreement between the three flights when normalized to the same reading at

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ground level, and the results are well represented by the same polynomial. There is a renewed indication of a hump and a depression in the regions previously reported by Bhabha and co-workers and Gill in their airplane ascents, and this cannot be attributed to temperature effect here since the temperature was very well controlled inside the gondola by the 'green house' effect. (auth)

3120 Nuclear Explosions Observed in Lead with Counters. André Cochon, Jean Daudin, and Roland Maze. Compt. rend. 230, 290-2(1950) Jan. 16 (in French).

When unaligned counters are embedded in lead the observed coincidences are influenced just as much by local events in the lead as by the penetrating particles present in the air. However, the author shows that coincidences in lead may be used to give information about bursts in air. The number of bursts liberating more than n ions is given $N_n = N_0 n^{-\gamma}$, where $N_0$ and $\gamma$ are empirical constants. The value of $\gamma$ may be estimated by from data obtained in lead.

3121 Observations of the Formation of Meson Pairs. A. P. Zhdanov and P. I. Lukirskiĭ. Doklady Akad. Nauk S.S.S.R. 69, 785-6(1949)(in Russian).

A peculiar distribution of grains was observed in two meson tracks, 1,274 and 1,225 $\mu$ long, obtained in photoemulsions at 6,000 m altitude. Almost rectilinear, the tracks exhibit a minimum of grain density in the middle and a steady increase toward both ends; evidently, each track shows two mesons projected in opposite directions from one point. Since no other charged particle is present, the generating particle must be neutral, viz., it must be either a photon, or a neutral meson, or a heavier particle (neutron). The photon hypothesis is eliminated by the consideration that such a photon's momentum would be impossibly high, while the neutron is ruled out because in that case the two mesons would move in almost the same direction. Thus, the process observed is a creation of two oppositely charged mesons by a neutral meson. By assuming the mass of each created meson to be 200 $m_e$, and its kinetic energy 4 Mev, we obtain for the mass of the neutral meson the value $\sim 416\ m_e$.

3122 On Evaporation Stars. E. Clementel and G. Puppi. Nuovo cimento 6, 494-9(1949)(in Italian).

By applying Weisskopf's evaporation theory (Phys. Rev. 52, 295(1937)) to the drop model of the nucleus, a theory is obtained which, at least for not too high excitation energies, accounts satisfactorily for the experimental data. The average numbers of ionizing prongs, as a function of the excitation energy, are calculated and compared with the known statistics on stars produced by 90-Mev neutrons and by mesons $\pi^-$. (auth)

3123 The Production of Nuclear Disintegrations and Neutrons at the Geomagnetic Equator. J. A. Simpson, Jr. and E. Hungerford. Phys. Rev.77, 847-8(1950) Mar. 15 (Letter to the editor).

Measurements of the low energy nuclear disintegrations or stars produced by the cosmic radiations have been extended to the geomagnetic equator over a range of altitudes where the star production is in equilibrium with its producing radiations. As in the earlier measurements (Simpson and Uretz, Phys. Rev. 76, 569(1949)) fast, electron collection argon ionization chambers were used which measured the total ionization energy loss in the chamber due to a star event and could discriminate between star and shower events. Concurrent measurements of the fast neutron production in air were made with boron trifluoride detectors. The star producing radiation was found to have an exponential dependence on atmospheric pressure and an absorption thickness of 210 ± 8 g/cm, while the corresponding absorption thickness for the fast neutron producing radiation is 201 ± 5 g/cm. It is concluded that the large atmospheric neutron production of initial energies below 10 to 20 Mev arises from the low energy nuclear disintegrations in the atmosphere. The authors also discuss the variation in neutron and star production between 0 and 53°N latitude.

3124 Review of Cosmic Rays. Thomas Hope Johnson. Connecticut Acad. Arts Sci. 38, 195-210(1950) Mar.

The author presents the basic experimental facts resulting from cosmic-ray and artificially produced meson studies and shows how the present incomplete picture of $\pi$- and $\mu$-meson production and decay attempts to account for these facts.

3125 Showers of Minimum Ionizing Particles from Cosmic-Ray Induced Nuclear Disintegrations in Nuclear Emulsions. B. T. Feld, I. L. Lebow, and L. S. Osborne. Phys. Rev. 77, 731-2(1950) Mar. 1 (Letter to the editor).

An analysis is presented of 15 disintegrations, each involving at least 5 relativistic particles, in plates exposed at altitudes exceeding 90,000 ft. A table lists, for each star, the number of minimum, and of near-minimum ionization tracks, the angle of the primary with the shower axis, the charges in the heavy and near-minimum ionization tracks, and the total observed charge. The authors conclude from their data, that minimum tracks must be predominantly of non-nucleonic origin, that it is possible to distinguish experimentally between disintegrations in light and heavy nuclei, and that for the same multiplicity of meson production the angular spread is much smaller for light than for heavy nuclei.

3126 Solar Magnetic Moment and Diurnal Variation in Intensity of Cosmic Radiation. Kirby Dwight. Phys. Rev. 78, 40-9(1950) Apr. 1.

The effect of the earth's magnetic field upon the orbits of of primary cosmic-ray particles is computed in detail for the special case of those particles arriving vertically anywhere on the earth's surface. A procedure is evolved for taking this deflection in conjunction with the previous deflection in the magnetic field of the sun, and thereby calculating for any given cosmic-ray energy spectrum an expected diurnal variation in total cosmic-ray intensity. Examples of this procedure are given for an inverse power spectrum applied to two different magnitudes of the solar magnetic moment. The sample calculations are made for several latitudes of observation, and the expected diurnal variation is then studied as a function of the solar magnetic moment and of the energy spectrum. The phase of the variation is found to be very sensitive to the solar moment, and so it is hoped that a successful experimental determina-

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tion of the diurnal variation will settle the question of the existence and magnitude of a permanent solar magnetic moment. (auth)

3127 Spectrum of Heavy Nuclei in the Primary Cosmic Radiation at 22 km. Hoang Tchang-Fong. Compt. rend. 230, 292-4(1950) Jan. 16 (in French).

The author has studied 123 tracks of heavy nuclei, recorded in Ilford G5 plates exposed in balloons at an altitude of 22 km. The charge numbers of the nuclei were determined by Δ-ray counts. The density of Δ-rays along the track is given by $n = Z^2/K\beta^2$, where K is an empirically determined constant, $\beta = 1/\sqrt{1-v^2/c^2}$. By examining tracks of known particles K was found to be 45. Momenta were determined from range-energy curves. The abundance of the nuclei is plotted against Z, and the energy spectrum of the particles as they enter the atmosphere is plotted. This spectrum is in conflict with Fermi's theory (Phys. Rev. 75, 1169(1949)).

3128 Regulated Low Voltage Power Supply. A. K. Solomon. AECU-734, nd. 5p.

A regulated low-voltage power supply has been designed for use with the d-c amplifiers in a mass spectrometer of the Nier type (Rev. Sci. Instruments 18, 398(1947)). It is a series regulator with 2 stages of amplification. The output is 225 v at a current of 190 ma. A battery instead of a resistance chain is used in the feedback circuit. There is no provision for adjustment of output voltage, since it can be varied by 1.5-v steps by adjusting the battery potential. Performance data and a circuit diagram are included.

3129 A High Megohm Bridge. F. M. Glass and R. K. Abele. ORNL-597, Mar. 9, 1950. 9p.

The instrument described here is a simple direct-reading Wheatstone bridge capable of rapidly measuring resistances up to $10^{13}$ ohms with 1% accuracy and $1.5 \times 10^{14}$ ohms with somewhat less accuracy. The need for this instrument arises out of the fact that almost any device for measuring very small (usually ionization) currents makes use of resistors in the range of $10^8$ to $10^{14}$ ohms, and the accuracy of the results is only as good as the precision with which the resistance values are known. The circuit consists of a 4-arm resistance bridge, balance of which is detected by a simple battery-operated vacuum-tube electrometer. Possible sources of inaccuracy and methods of avoiding them are discussed.

3130 High Speed Oscilloscope; Interim Engineering Report No. 3 for February 1, 1949, to June 15, 1949. Howard Vollum and Richard R. Rhiger. Tetronix, Inc., July 8, 1949. 9p. (AEC File No. NP-1393.)

The preliminary development work on the various circuits of the high-speed wide-band oscilloscope has been been completed, and actual construction of the instrument is now under way.

3131 Noncontacting Beta-Ray Thickness Gage. C. W. Clapp and S. Bernstein. Gen. Elec. Rev. 53, 31-4 (1950) Mar.; Elec. Eng. 69, 308-10(1950) Apr.

It is proposed that the absorption of β rays be used to determine the thickness of homogeneous sheets of material which cannot be placed in contact with another type of gauge.

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Curves are given for the absorption of β rays from strontium 90, cesium 137, and cesium 134 in various thicknesses of aluminum. These curves are very similar for other materials if their thickness is expressed in equivalent thick- of aluminum. The experiments described in this article have been conducted with strontium 90, using an ionization chamber as a detector. A modulator was used between the the sheet and the source, interrupting the beam 90 times a second. The output of the ion chamber was put through an a-c amplifier and then rectified and measured by means of a d-c milliammeter. An analysis is given of the signal to noise ratio in the output of the ion chamber, and a circuit diagram is given for the synchronous rectifier used with the a-c amplifier.

3132 A Simple Contamination-Free Electron Gun. H. E. Farnsworth. Rev. Sci. Instruments 21, 102(1950) Jan. (Laboratory and shop note).

In the usual type of electron gun, with the cathode mounted on the axis, evaporated material from the hot cathode produces observable contamination of a solid target in the course of several hours. If the cathode is composed of an electropositive metal which does not evaporate in the form of positive ions, these impurities may be eliminated by mounting the cathode off the axis and deflecting the electron beam with an electrostatic field. A thorough outgassing of the electrode eliminates the possibility of contamination by negative gas ions. Such an electron gun, similar to one previously described by the author (Rev. Sci. Instruments 15, 290(1927)), has been designed. The new features of this electron gun, as compared with the gun previously described, are the off-axis position of the cathode and the addition of another electrode. The gun has been used with tantalum and tungsten cathodes, heated by conduction, and no contamination occurred in a period of several hours.

3133 Steady-State Internal Temperature Rise in Magnet Coil Windings. Claude L. Emmerich. J. Applied Phys. 21, 75-80(1950) Feb.

The temperature distribution in an electric coil winding is determined by solving the differential equations which apply to the system approximately. The maximum and average temperature rises are given for several types of windings. A distinction is made between small and large temperature rise; the treatment of the former neglects local changes in resistivity and thermal conductivity caused by the increase in temperature. A correction factor is computed to obtain the actual temperature rise from the much simpler calculations for the maximum temperature rise which would occur if the resistance were independent of temperature. It is found that nonuniform windings, wound of several different wire sizes to minimize the resistance, exhibit the same temperature-rise characteristics as conventional uniform windings of zero curvature. (auth)

3134 The Freezing-in of Nuclear Equilibrium. A. R. Ubbelohde. Proc. Phys. Soc. (London) 61, Pt. 1, 96-7(1948) July.

In a previous paper (Proc. Phys. Soc. (London) 59, 139 (1947)) a method was described for testing whether the abundance ratios of stable isotopes might be due to the freezing-in of thermodynamic equilibrium. The test was

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constructed so as to avoid uncertainties about the density of the system and the mass of the neutron at the time of freezing-in. From the freezing-in curve a freezing-in temperature was calculated of approximately $10^{100}$ K. Using the data on isotopes as presented by Mattauch (Nuclear Physics Tables, New York, Interscience Publ., 1947) and Stephens (Revs. Modern Phys. 19, 19(1947)), the auther concludes that it is possible to explain thermodynamically the abundance ratios of the isotopes $B^{11}$, $C^{13}$, $O^{17}$, $Ni^{60}$, $Ni^{62}$, and $Ni^{64}$, but not of the isotopes $He^3$, $N^{15}$, and $Ni^{64}$ unless the reactions maintaining equilibrium have a very unusual velocity.

3135 The Occurrence of Heavy Odd-Odd Isotopes in Nature. A. Broniewski. Phys. Rev. 77, 846-7(1950) Mar. 15 (Letter to the editor).

Recently two observers (Hess and Inghram, Phys. Rev. 76, 1717(1949); Leland, ibid., 1722(1949)) have found experimentally a naturally occurring isotope of vanadium, $V^{50}$. The discovery of this isotope was rather unexpected since it is an odd-odd isotope lying between the two adjacent isobars $Cr^{50}$ and $Ti^{50}$. The author points out a possible connection between the existence of such an isotope and the shell structure of the nuclei. $V^{50}$ contains 27 neutrons, one neutron less than a closed shell. Spectroscopic analogies indicate a high binding energy for the last neutron in such a case, and other similar examples may be found in the table of elements. The odd-odd naturally occurring isotope $La^{138}$, which also lies between two stable isobars, displays an analogous configuration. Such considerations indicate the existence of hitherto unknown stable isotopes.

3136 Oxygen Isotope Exchange in the Electric Discharge. W. E. Roake and Malcolm Dole. J. Am. Chem. Soc. 72, 36-40(1950) Jan.

No evidence for the exchange of oxygen isotopes between oxygen and water vapor could be discovered on passing the two through an electric discharge cell at low pressures and at −40° in the presence of a parallel magnetic field. However, a significant exchange was found to exist when oxygen and carbon dioxide were the gases in the cell. The relation of these results to the problem of the enhanced $O^{18}$ content of the atmosphere is discussed, and a theory for the latter is given which seems for the first time to be quantitatively possible. (auth)

3137 Inactive Isotopes, Their Separation and Applications. Gerhard Dickel. P. 7-17 in FIAT Review of German Science, 1939-1946: Physical Chemistry. Klaus Clusius (senior author). Office of Military Government for Germany, Field Information Agencies Technical, 1948 (in German).

This review article contains a list of 74 references with a brief connective text on the detection, separation, and applications as tracers of isotopes.

3138 The Mass Spectrometer; Its Accomplishments, Applications and Future. Kenneth E. Burmaster and Ernest C. Evans. Instruments 23, 242-5 (1950) Mar.

This is a review article describing the principles of operation and some of the main types of mass spectrometers. Thirty-one literature references are given, most of which deal with the application of mass spectrometry to chemistry.

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3139 Expansions of Functions in Series in Mathematical Physics. Josef Lense. In FIAT Review of German Science, 1939-1946: Pure Mathematics, Part I. pp. 181-8. Wilhelm Süss (senior author). Office of Military Government for Germany, Field Information Agencies Technical, 1948 (in German).

This article summarizes recent results concerning the expansions of functions in series as they occur in mathematical physics. Included are Fourier series, as well as series of Bessel, Legendre, $\Gamma$, and Lamé functions. 23 literature references.

3140 A Form of Green's Transformation. C. A. Truesdell. Naval Research Laboratory Report No. NRL-3554, Oct. 11, 1949. 7p.

A new form of Green's transformation of volume into surface integrals is derived. This form contains as special cases numerous formulas of hydrodynamics and electromagnetic theory. 10 references. (auth)

3141 Special Functions of Mathematical Physics. Wilhelm Magnus. In FIAT Review of German Science, 1939-1946: Pure Mathematics, Part I. p. 159-79. Wilhelm Süss (senior author). Office of Military Government for Germany, Field Information Agencies Technical, 1948 (in German).

This review article describes results recently obtained for various functions which are of importance in mathematical physics, including $\Gamma$, hypergeometric, confluent hypergeometric, Bessel, elliptic, spheroid, and Mathieu functions. 30 literature references.

3142 Final Report on Production Engineering of Beta-Gamma Hand and Foot Monitor. R. K. Dickey. M-4456, Aug. 25, 1949. 21p.

This report is a summary of all progress reports on this project. The purpose of the project was to engineer and design for production the Beta-Gamma Hand and Foot Monitor. The unit was to be as small as possible, consistent with safety and practical design, and capable of satisfactory operation and storage under extremes of temperature and humidity. The type of design used in this unit and the testing results indicate that it should operate very reliably in continuous service. The mechanical design system used should make service and repair exceptionally easy. Tests showed that the instrument can count pulses with absolute accuracy and that there are no spurious counts. Therefore the accuracy of its measurement is limited only by that of the counter tubes used.

3143 Background Eradication in Thick-Layered Nuclear Emulsions. Martin Wiener and Herman Yagoda. Rev. Sci. Instruments 21, 39-41(1950) Jan.

A method for eradication of accumulated background on Ilford C-2 plates, 100 to 200 $\mu$ thick, without reducing their sensitivity to medium ionizing particles, is described. The method involves a mild oxidation of the emulsion by air saturated with water vapor at 35°C for a period of about 16 hr. The plates are then dried and are ready for experimental exposure. Analysis of grain counts shows no loss of sensitivity in proton tracks over their last 200-$\mu$ range when the plates are developed with a mild hydroquinone developer. Complete eradication of background $\alpha$ tracks and stars

is secured, as well as destruction of latent images of the less ionizing proton recoils instigated by external neutron bombardment. Grain-density studies on proton tracks located at different depths in the emulsion indicate substantially uniform sensitivity after eradication except for those in the uppermost 50 $\mu$ which develop with about a 10% reduction in mean grain density as compared with tracks deep within the recording medium. (auth)

3144 Beta-Gamma Angular Correlation. Theodore B. Novey. Phys. Rev. 78, 66-7(1950) Apr. 1 (Letter to the editor).

Measurements on angular correlation in $\beta$-$\gamma$-ray cascades have been made, using anthracene scintillation counters in connection with liquid-nitrogen–cooled 1P21 photomultiplier tubes. The sources were mounted on rubber hydrochloride films (~0.6 mg/cm$^2$) and were located in the center of a plastic vacuum chamber 6 in. in diameter. A mica window (3 mg/cm$^2$) was located at the $\beta$-crystal counter position, and the coincidence circuit, with blocking oscillator pulse shaping and pentode mixing, gave a resolving time of 0.08 $\mu$sec. $Tm^{170}$ was chosen for investigation because of its high ft value ($6.3 \times 10^8$). Preliminary measurements indicated a high correlation with a value of $\epsilon = 0.4 \pm 0.1$, assuming the correlation function $(1 + \epsilon \cos^2 \theta)$. Values of the correlation constant are also given for $Rb^{86}$, $Co^{60}$, and $Sc^{46}$.

3145 British Radio-Activity-Measuring Apparatus. Denis Taylor. Brit. Sci. News 3, 117-22(1950) Feb. (See also NSA 3-2002.)

This article describes recent developments in the technique of radioactive measurements and the new instruments now becoming available to British scientists. Several types of assay instruments are now being manufactured. The authors discuss one such instrument, which makes use of a flow-type proportional counter. This counter can be used for both $\beta$ and $\alpha$ emitters. Typical counting rate–voltage curves are given for a $\beta$ and an $\alpha$ source. Two instruments, utilizing scintillation counters for $\alpha$ and $\gamma$ assay work, are also described. The authors also mention several types of counters embodying automatic counting apparatus and new types of health monitors.

3146 The Characteristics of Electronic Photomultipliers Used as Scintillation Detectors. M. Ageno, M. Chiozzotto, and R. Querzoli. Rend. ist. super. sanità 12, 265-78(1949) (in Italian).

A similar article has appeared in Nuovo cimento 4, 217(1949). An abstract of that article has appeared in Nuclear Science Abstracts as No. 3-1992.

3147 Determining the Components of, and Producing a Photo-Multiplier. A. Lallemand. Vide, Le 4, 618-24(1949) May (in French).

The requirements of the components of a photomultiplier are discussed. It is pointed out in this connection that the Johnson effect is of greater importance than the Schottky effect for the operation of the photomultiplier. Ag-$Cs_2O$-Cs photocathodes are not recommended because of the dark current produced by infrared radiation. Sb-Cs cathodes are stated to be very sensitive to ultraviolet, since they have extremely low thermal currents. It is recommended that targets be made of Ag-Mg, which is nonphotoelectric. A new geometrical design has been worked out to eliminate parasitic electrostatic fields. A 17-stage multiplier with a sensitivity of 67 A/lum and a total amplification of 850,000 at 120 v/stage permitted measurement of illuminations above $5 \times 10^{-11}$ lum.

3148 The Distribution of Radiation Near the Geometrical Edge of an X-ray Beam. H. E. Johns and E. K. Darby. Brit. J. Radiol. 23, 193-7(1950) Mar.

Using an apparatus similar to the one used by Meredith with large ionization chambers, the authors developed a technique and apparatus for the measurement of radiation near the geometrical edge of an x-ray beam. The radiation was measured to within 1 mm of the edge, and discontinuities were found. The apparatus and experiments are described in detail; the results agree with calculations from other methods. A limiting diaphram reduced the sharp discontinuities in the curves, but discontinuities in slope persisted. Graphs of per cent depth dose against depth and distance from the axis and isodose curves are included.

3149 The Formation of Droplets on Ions in Wilson Cloud Chambers. M. Pollermann. Ann. Physik 5, 329-48 (1950) (in German).

A method is described of measuring the electric mobility of ions during the expansion of a cloud chamber, which makes it possible to observe the growth of the ion radii and the beginning of spontaneous droplet formation. The experimental results are in good agreement with the theory of droplet formation of Thomfor and Volmer (Ann. Physik 33, 109(1938)) and confirm its applicability to conditions in a cloud chamber.

3150 Gamma-Scintillations in Diphenylacetylene. C. F. Ravilious, J. O. Elliot, and S. H. Liebson. Phys. Rev. 77, 851(1950) Mar. 15 (Letter to the editor).

Koski and Thomas (Phys. Rev. 76, 308(1949)) have recently reported the observation of scintillations in diphenylacetylene and have estimated the signal-to-noise ratio of diphenylacetylene to be six times better than that of stilbene. Measurements reported by the authors indicate that diphenylacetylene is a much more efficient phosphor, with a luminescence decay constant of $8 \times 10^{-9}$ sec at room temperature. This time measurement was made by a shorted coaxial line technique in which the output pulse generated by the photomultiplier tube is partially canceled by its own out-of-phase reflection from the variable-length shorted line. The experiment was carried out with a 931-A photomultiplier operating at 200 v/stage which was cooled by liquid nitrogen. A radium $\gamma$-ray source was used for excitation.

3151 The Geiger-Müller Counter. Leon F. Curtiss. Washington 25, D. C., U. S. Government Printing Office, 1950. 23 p. (National Bureau of Standard Circular 490.)

This monograph gives a brief description of the nature, construction, and use of Geiger-Mueller counters. Specific examples are given of counters developed for particular uses such as the recording of gamma rays, beta rays, or cosmic radiation. Means of detecting counter pulses are discussed, such as mechanical recorders, scale and rate meters, and the application of counters to quantitative measurements, with

special reference to statistical fluctuations, resolving time, absorption and backscattering of beta rays, and coincidence counting. Finally, brief mention is made of the construction of proportional counters and the preparation and filling of Geiger-Mueller counters. An extensive, but selected bibliography covers the literature up to and including 1948.

3152 Granularity Measurements of X-ray Emulsions Exposed to X-rays with Increasing Quantum Energy. R. H. Herz. Phot. J. 89B, 89-96(1949) July-Aug.

X-ray emulsions exposed to x-rays of increasing hardness show an increase of granularity up to short wavelengths of the order of 0.1 to 0.04 A, as measured with a photoelectric granularity meter. At still shorter wavelengths (1,000 kv and $\gamma$ radiation) the granularity decreases slightly. The percentage increase of granularity changes with the type of emulsion. It is believed that the increase of granularity is due to group formation of developed AgBr grains mainly caused by photo- and recoil-electrons released by higher energy quanta. The different behavior of various emulsions with regard to the increase of granularity is supposed to be influenced by the mean distance between grains of different emulsions. Exposures with water-swollen films and with emulsions having different Ag-gelatin ratios show some evidence that the separation of grains is partly responsible for the effect. From the speed relationship between dry and wet emulsions exposed to x-rays of different hardness, conclusions were drawn that more grains are made developable per absorbed quantum of high energy compared with a quantum of low energy. (auth)

3153 How to Compare Counters. Alexander Thomas. Nucleonics 6, 50-3(1950) Feb.

The factor of merit for two counters is defined as the ratio of the counting times required by the two counters in order to give the same accuracy. The author derives the expressions necessary to calculate this quantity from the counting rates of the individual counters with and without a source.

3154 Ideas Concerning the Mechanism of Conduction in Cadmium-Sulfide Crystals. Immanuel Broser, Hartmut Kallmann, and Ruth Warminsky. Z. Naturforsch. 4a, 631-7(1949) Nov. (in German).

On the basis of earlier work on the electrical conductivity of CdS crystals, concepts are developed to describe the mechanism of this conductivity which can be brought about equally well by excitation with light, x-rays, $\gamma$ rays, and corpuscular radiation. Special attention is paid to the connection between luminescence and conductivity of the crystals. In nonactivated crystals the transport of electricity is considered comparable to the transport of charge in gases, so that the transported amount of electricity depends on the number of excited carriers. In activated crystals an instantaneous recombination of the excited electrons is prevented at the spots of disturbance, whereby a metallic conduction band is formed, which makes possible greatly increased transport of charge.

3155 An Improvement Effect of the Plateau in Xylene- and Argon-Filled Geiger Counters. Besim Tanyel. Phys. Rev. 77, 843-4(1950) Mar. 15 (Letter to the editor).



A counter consisting of a wire between two parallel copper-coated steel plates was evacuated, baked at 400°C, then refilled with a xylene and argon mixture at 76 cm Hg, admitting first the xylene vapor under a pressure of 9 mm Hg. The tube was then sealed to a manifold. After a rest period of 42 hr, the plateau was found to be unsatisfactory. A steady improvement was observed in the plateau characteristics at the end of 216 and 336 hr. It is believed that this improvement is due to the formation of a continuous xylene film on the cathode. In order to determine the effect of the partial removal of this film, the tube was heated to 120°C, kept at that temperature for 10 min, and left in the oven to cool slowly. Immediately after the heating the plateau had a high slope, but after 28 hr of rest, recovery was almost complete. The process of film formation in various types of counters is discussed.

3156 An Improved Resolving-Time Measuring Device. B. W. Roberts, Jr., K. E. Perry, and R. G. Fluharty. M. I. T. Laboratory for Nuclear Science and Engineering Technical Report No. 41, Mar. 15, 1950. 40p. (AEC File No. NP-1437.)

A circuit for measuring counter resolving times has been developed, utilizing the scheme of Curran and Rae (Rev. Sci. Instruments 18, 871(1947)), with the addition of a delayed pulse of variable width. Any random event initiates a delayed pulse which is fed into the circuit in coincidence with subsequent pulses, giving rise to a sharp increase in the coincidence rate at a delay time close to the resolving time. A theory is given which agrees well with experimental results, and data are included for several counters to illustrate the operation under different counting rates and overvoltages. 11 references. (auth)

3157 Ionization Chambers and Counters: Experimental Techniques. Bruno Rossi and Hans H. Staub. New York, McGraw-Hill, 1949. 243p. NNES Div. V, Vol. 2.

A review of this book has appeared in S. African J. Sci. 46, 229(1950) Feb., and was listed in Nuclear Science Abstracts as No. 3-2311.

3158 A Proportional Counter X-ray Spectrometer. W. Bernstein, H. G. Brewer, Jr., and W. Rubinson. Nucleonics 6, 39-45(1950) Feb.

This paper describes a proportional-counter x-ray spectrometer useful in the 1 to 50-kev range. This instrument consists of a counter, preamplifier, amplifier, high-voltage supply, pulse-height analyzer, two scalers, and a register. The authors discuss several factors affecting the design of the proportional counter, such as the necessity for a linear relation between the photon energy and the pulse amplitude and the desirability of minimizing recombination of the ions. A circuit diagram of the entire apparatus is given, and the operating characteristics are described. The counters are operated between 1,500 and 2,100 v, depending on the counter filling, and the amplification factor is about $10^3$. The measured gain of the preamplifier and the amplifier is about 45,000. Several representative x-ray spectra are reproduced.

3159 Preliminary Report on the Beta-Spectrometer Design Investigation. Parts I and II. Stanley F. Frankel and Eldred C. Nelson. University of Southern

California, June 1948. 20p. (AEC File No. NP-1120.)

Part I: Existing Equipment. Various types of instruments have been used to determine the energy distribution of the electrons (positive or negative) emitted by a radioactive sample. All such instruments will here be referred to as $\beta$ spectrometers if they serve to produce a spatial separation of the components of the $\beta$-ray beams by the use of electrostatic and/or magnetic fields. The following instruments are discussed: the 180-deg focusing spectrometer; the linear-shimmed 180-deg spectrometer; the 60-deg spectrometer; the double-focusing spectrometer; the Langer-Cook spectrometer; the helical-focusing spectrometer; the thin magnetic-lens spectrometer; the thick magnetic-lens spectrometer; the electrostatic-focusing spectrometers. Qualitative comparisons are made concerning copper and power requirements, resolution efficiency, behavior of the counter in a magnetic field, the use of iron in the magnet, and flexibility. The comparisons seem to indicate that for use with low-intensity continuous spectra (which is the present primary interest), the magnetic-lens spectrometer would be considerably superior to other existing types if its dispersion could be made at least quadratic in the solid angle. The following methods of improvement of the magnetic-lens spectrometer are discussed: removal or reduction of spherical aberration and exploitation of the astigmatism of the magnetic lens and its application to the special case of the solenoid spectrometer.

Part II: Theoretical and Calculational Aspects. The representation of the magnetic field is discussed under introduction of the vector potential, the field equation limiting the vector potential, and simple magnetic field shapes. The electron-path equation is derived and the initial conditions given.

3160 Radiation Surveys with a Scintillation Counter. George M. Brownell. Econ. Geol. 45, 167-74(1950) Mar.-Apr.

A portable scintillation counter for measuring radiation intensities with speed and accuracy has recently been developed. This new instrument is about 100 times more sensitive than a portable Geiger counter and will find particular use in the search for and development of radioactive mineral deposits. The instrument can be used for making accurate assays of radioactive samples and may be used as a spectrometer to distinguish between uranium and thorium in ores. An account is given of the first use of portable scintillation counters in making radiation surveys over pitchblende deposits in the Lake Athabaska region. Maps were constructed showing "isorads," or zones of equal radiation intensity about the pitchblende deposits, that provided a pattern of the vein system and located new veins. Over territory where no known pitchblende deposits occurred, the survey picked out zones of radiation where search should be concentrated. (auth)

3161 Recent Applications of Electron Multiplier Tubes. James S. Allen. Proc. Inst. Radio Engrs. 38, 346-58 (1950) Apr.

Recent applications of the electrostatic electron multiplier tube to problems which require the measurement of very small currents or the counting of single ions or electrons are described in this paper. The characteristics of secondary-electron-emitting surfaces suitable for use in multiplier tubes are discussed in the first section. The next section is devoted to recently developed tubes having one or more stages of electron multiplication. Following this is a section dealing with the application of these tubes to problems involving electron and ion counting. The paper is concluded by a section on the statistical treatment of the distribution in pulse sizes from multiplier tubes. (auth)

3162 A Stabilizer for Proportional Counters. D. H. Wilkinson. J. Sci. Instruments 27, 36-8(1950) Feb.

It is pointed out that the conventional proportional counter is not a precision instrument when used over a long period of time because the gas amplification of the counter is not completely stable. It is proposed to remedy this defect by introducing into the counter a source of $\alpha$ particles, e.g., radioactive polonium. The emitted $\alpha$ particles will give rise to a group of pulses well separated from those under investigation if, as is customary, the proportional counter is used to detect events of rather low energy. A control circuit is employed to keep the amplitude of the amplified pulses from the $\alpha$ particles constant. Thereby stable amplification for all pulses will be assured.

3163 Temperature Variation of Decay Times of Scintillation Phosphors. S. H. Liebson and J. O. Elliot. Phys. Rev. 78, 65(1950) Apr. 1 (Letter to the editor).

A decrease in the decay times of $\gamma$ scintillations with decrease in temperature, reported by Kelley and Goodrich (Phys. Rev. 77, 138(1950)), has been corroborated by the authors. Measurements of the variation of organic phosphor times with temperatures, using a shorted-line technique, gave the following results: anthracene at 290°K, $3.2 \times 10^{-8}$ sec; anthracene at 80°K, $1.4 \times 10^{-8}$ sec; anthracene at 4°K, $6 \times 10^{-9}$ sec, which was within the resolving time of the photomultiplier. This behavior is probably characteristic of the molecules rather than the lattice. These preliminary measurements are believed to have an over-all accuracy of better than 20% and are based on pulse shapes having the form $e^{-t/\tau}$.

3164 Theory of Beta Spectrograph, Siegbahn Type. Geneviève Paquien and Pierre Grivet. Compt. rend. 230, 65-7(1950) Jan. 2 (in French). (See also NSA 4-2413.)

Siegbahn (Phil. Mag. 37, 162(1946)) has proposed a $\beta$ spectrograph with a nonuniform magnetic field having maximum intensity at both ends of the particle trajectory and a minimum in the intermediate portion. The authors calculate the length of the trajectory and the magnetic field strengths required in such an apparatus, assuming a given variation in field strength over the trajectory. This is the first of two articles.

3165 Utilization of Photographic Plates in Determining and Measuring Weak Radioactivity. R. Coppens. Bull. soc. sci. Bretagne 23, 17-26(1948)(in French).

The detection and measurement of radiations by means of ionization chambers, fluorescent screens of ZnS, and photographic plates are discussed, with particular reference to the detection of radioactive elements present in small amounts in rocks. The results of a number of such assays by means of photographic emulsions are reported.

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3166 Generation and Amplification of Waves in Dense Charged Beams under Crossed Fields. O. Buneman. Atomic Energy Research Establishment Report No. AERE-T/R-431, Nov. 23, 1949. 3p.

A study has been made of dense beams of charged particles in crossed electric and magnetic fields under geometrical conditions rather simpler, yet more general, than in the magnetron. The mechanism responsible for magnetron oscillations was found to be effective under the new conditions and in no way dependent on the peculiarities and complications of magnetron geometry. The mechanism thus acquires a more fundamental significance and might, tentatively, be added to the list of mechanisms cited as possible explanations of solar noise. Oscillations were obtained as the outcome of ordered motion of charge under the external fields and purely long-range coulomb forces. There is no need to invoke collision phenomena, high temperatures, or interaction between charges of two kinds (such as ions and electrons in plasmas). Moreover, the process is purely electrostatic (the velocity of light does not enter) and can occur at low fields and low frequencies. As a means of generating microwaves, the device investigated is attractively simple. 10 references.

3167 Neutron-Proton Scattering at 27 Mev. J. E. Brolley, Jr., J. H. Coon, and J. L. Fowler. AECU-628, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

Neutrons of average energy of 27.4 Mev and with a maximum spread in energy of 1 Mev were produced by bombarding gaseous tritium with deuterons accelerated by the cyclotron. Recoil protons from a polyethylene radiator 0.02 in. thick were observed at 0, 15, 30, 37.5, 45, and 52 deg in the laboratory system. Quadruple coincidence counting of the protons was performed with a fourfold proportional-counter system. Sufficient aluminum absorber was inserted between the two remote counters to absorb low-range background particles. The neutron yield was monitored by the charge incident on the target as measured by a condenser-type integrator. Angular distributions were obtained with two series of runs, one with the radiator at 5.7 in. and the other at 15.3 in. from the center of the target. The two sets of data agree and show that the distribution is definitely anisotropic. The ratio of the differential scattering cross section at 180 deg to that at 90 deg in the center of mass system is 1.3. (auth)

3168 Fast Neutron Capture Cross Section of $Al^{27}$ as a Function of Energy. R. L. Henkel and H. H. Barschall. AECU-729, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

The fast neutron capture cross section of $Al^{27}$ has been measured by observing the 2.4-min activity of $Al^{28}$. This activity was induced by neutrons of energies between 150 and 700 kev. Radiative capture is the only absorption process in this energy range. Neutrons of variable energy were produced by the $Li^7(p,n)Be^7$ reaction, using the Wisconsin electrostatic generator. Cross sections were determined by comparison with the known thermal capture cross section of aluminum. A $BF_3$ proportional counter was employed for monitoring the neutron flux during this comparison, making use of the known energy dependence of the disintegration cross section of boron. The aluminum capture cross section in the energy range studied has values between 1 and 6 millibarns and shows resonance levels corresponding reasonably well to those levels found in the total neutron cross section. A quantitative comparison between level energies is made difficult by the complicated level structure and the poor energy resolution (20 to 30 kev) used in this preliminary work. (auth)

3169 Neutron Spectrum from Proton Bombardment of Beryllium. V. R. Johnson, M. J. Wilson Laubenstein, and F. Ajzenberg. AECU-731, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

A thin foil of Be, 1.7 $\mu$ thick, was mounted on a tantalum backing and bombarded with 3.815-Mev protons produced by the Wisconsin electrostatic generator. Eastman NTA nuclear emulsion plates 100 $\mu$ thick were mounted 4 in. away from the target at angles of 0, 45, and 90 deg with respect to the incident beam. A total of 400 tracks have been measured on the 0-deg plate. A plot of this data, after being corrected for variation of the n-p scattering cross section and for geometry, shows clearly the group from the ground-state transition of the reaction $Be^9(p,n)B^9$ with a half-width of the curve of about 0.12 Mev. There is also observed a continuous distribution of neutrons extending from the ground-state group down to low energies. The average ordinate of this continuous distribution is less than one-tenth the height of the ground-state peak. Comparison with the earlier $Li^7(p,n)Be^7$ spectrum measurements under similar geometry indicates that this continuous distribution does not result from scattered neutrons. These low-energy neutrons can be attributed to the $Be^9(p,pn)Be^8$ reaction. Measurements on the other plates are in progress.

3170 A Study of the Slowing Down Distribution of $Sb^{124}$-Be Photo Neutrons in Graphite, and of the Use of Indium Foils. L. D. Roberts, J. E. Hill, and G. McCammon. ORNL-201, Feb. 24, 1950. 25p.

The spatial neutron slowing-down distribution, i.e., the distribution of 1.44-ev neutrons, has been measured in graphite, using an $Sb^{124}$-Be photoneutron source. The detector used was indium covered with cadmium, with cadmium and indium, or with boron. The results are as follows: (1) from an integration of the Boltzmann equation, G. Placzek (MDDC-2) has calculated the slowing-down distributions which have been measured here; the measurements reported here are in good agreement with Placzek's calculation; (2) the energy of $Sb^{124}$-Be photoneutrons has been obtained by fitting these measurements to Placzek's theory; a value of ~20 kev was obtained, in fair agreement with previous work; (3) resonance activation of indium by neutrons in an energy range from the 1.44-ev resonance to several thousand electron volts has been shown to make an important contribution to the slowing-down distribution measured by the 54-min activity of an indium foil. A method is given for precisely subtracting out this high-energy activity, giving a remainder due to the 1.44-ev resonance only. Preliminary measurements with rhodium and gold show similar high-energy activation in addition to that due to the low-energy resonance. 12 references. (auth)

3171 Piece-Wise Greuling Solutions for Hydrogen. Gale Young. ORNL-415, Sept. 28, 1949. 8p.

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The neutron scattering cross section $\sigma$ of hydrogen varies inversely with neutron energy E at high values of E and with increasingly lower powers of E as E decreases. Any single-power law of variation can be dealt with, in the "straight ahead" approximation method of Greuling. The author considers the piecing together of such solutions in different energy regions to get an over-all approximation.

3172 Total Cross-Sections of Light Elements as Obtained from G. H. Williams, E. Lampi, G. D. Freier, University of Minnesota. W. K. Ergen. ORNL-426, Oct. 5, 1949. 8p.

Total cross sections in barns as a function of incident neutron energy up to about 2 Mev are tabulated for S, Mg, Si, C, and O.

3173 A Nomograph for Materials Irradiation. Janet M. Cisar. NEPA-1197, Nov. 9, 1949. 10p.

A nomograph has been constructed to provide a rapid, relatively simple, and reasonably accurate method for carrying out calculations involving source radiation intensity. For any material of known neutron absorption cross section and half-life, any one of the following possible variables may be determined, given a value for each of the others: pile flux, irradiation time, and source radiation intensity. Since the nomograph gives source intensity per mole, an auxiliary nomograph is included to aid calculation of the number of moles from atomic weight and grams of material used. (auth)

3174 Experiments on N-P Scattering with 260-Mev Neutrons. E. Kelly, C. Leith, E. Segre, and C. Wiegand. UCRL-626, Mar. 6, 1950. 15p.

When the circulating 350-Mev proton beam of the 184-in. cyclotron is intercepted by a beryllium target at a radius of 81 in., high-energy neutrons are produced with an energy-distribution maximum at about 260 Mev. By use of this neutron beam with a low energy cutoff at 200 Mev, n-p scattering experiments have been performed, similar to those previously done with neutrons of 40 and 90 Mev mean energies (Hadley, et al., Phys. Rev. 75, 351(1949)). The differential scattering cross section has been measured as a function of the scattering angle of recoil protons from a hydrogen target. The results are summarized in a graph.

3175 Investigation of Nuclear Reactions and Scattering Produced by Neutrons. Raemer Edgar Schreiber. Purdue University, June 1941. 156p. (AEC File No. N-1810.)

The construction and performance of a neutron generator consisting of a low-voltage arc and an accelerating tube are described. Deuterons are formed by ionization of heavy hydrogen gas in the arc source, focused by an electrostatic lens system, and accelerated by a van de Graaff-type generator. When these ions fall on a target of heavy ice, neutrons are formed by the deuteron-deuteron reaction. A study of the relative activities of the 54-min and the 4.1-hr periods of indium is made, showing that the latter period is activated principally by fast neutrons. Absorption measurements give a cross section for resonance neutrons in indium which agrees with previous values. Two separate attempts are made to detect the diffraction of neutrons, using a focusing method. Results are not conclusive because of high background and low intensities, but indicate that the diffraction intensities must be small. The effect of neutron energy on the mode of uranium fission is investigated, using neutrons from the Be-D and Li-D reactions in the cyclotron, a special ionization chamber, linear amplifier, and recording oscillograph. Plots of the number of pulses versus recoil energy of the fragments are made. With slow neutrons, an energy distribution of single fragments agreeing with that of former investigations is found. With fast neutrons, three new modes of fission are assumed to exist: highly asymmetrical binary, symmetrical binary, and symmetrical ternary. By applying the law of conservation of momentum, it is possible to calculate the relative masses of the fragments in each case. The results agree with those obtained by using chemical analysis. Using a uranium layer on a thin supporting foil, measurements on the total ionization are made. These agree with the energies calculated from the single fragments and correspond with those calculated theoretically. The energy loss by single fragments which have traversed the supporting foil agrees closely with that calculated from the cross sections given by Knipp and Teller (Phys. Rev. 59, 659(1941)). 43 references. (auth)

3176 A Lower Bound on the Range of Neutron-Proton Interaction. A. A. Broyles and B. Kivel. Phys. Rev. 77, 839(1950) Mar. 15 (Letter to the editor).

The authors give an expression for the quadrupole moment of the deuteron, when ordinary and tensor forces are assumed to exist, in terms of two functions of r which depend on the form assumed for these forces. It is shown that, regardless of the magnitude or shape of these functions, this expression will not give a high enough quadrupole moment unless the largest range of interaction is greater than 0.39 $e^2/mc^2$. Recent changes in the binding energy and quadrupole moment of the deuteron are not great enough to alter these conclusions materially.

3177 On the Scattering of Fast Neutrons by Non-Central Interaction. Bengt Holmberg. Kgl. Fysiograf. Sällskap. Lund Förh. 18, 88-117(1948)(In English).

This article is based on an original dissertation which has been listed in Nuclear Science Abstracts as No. 2-1805.

3178 The Thermal Neutron-Capture Cross Section of $A^{36}$. G. E. McMurtrie and D. P. Crawford. Phys. Rev. 77, 840(1950) Mar. 15 (Letter to the editor).

The thermal neutron-capture cross section of $A^{36}$ has been measured as 6.5 ± 1.0 barns. Approximately 500 cc (N.T.P.) of commercial argon was sealed in a boron-free glass flask and irradiated in the thermal column of the Chalk River pile for 1 hr. The neutron flux through the gas was measured with manganese foils and found to be $8.6 \times 10^9$ neutrons/$cm^2$/sec. After removal of the flask from the reactor, the 110-min $A^{41}$ activity was allowed to decay through 40 half-lives before introducing an accurately measured pressure (10.58 cm) of the irradiated gas into a proportional counter preparatory to counting the $A^{37}$ activity. The activity thus determined was corrected back to zero decay time, using a half-life value of 34.1 days for $A^{37}$. The calculation of the cross section was based on an isotopic abundance of 0.307% for $A^{36}$.

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3179 Summary of the Research Progress Meeting of January 19, 1950. Henry P. Kramer. UCRL-600, Feb. 10, 1950. 9p.

Research on the following topics is discussed: construction of a $\beta$-ray spectrometer; detection of $\gamma$ radiation from the reaction of $\pi^-$ mesons on hydrogen; the yield of high-energy $\gamma$ radiation from proton-proton collisions and the half-life of the neutral mesons which are postulated to decay into the observed $\gamma$ rays.

3180 Summary of the Research Progress Meeting of January 12, 1950. H. P. Kramer. UCRL-602, Feb. 10, 1950. 9p.

Research on the following topics is discussed: investigation of the mechanism by which protons are ejected from nuclei by $\gamma$-ray photons in the energy range from 20 to 30 Mev, where the probability for the $(\gamma,p)$ reaction is at a maximum; experiments under way to measure the energy distribution and angular distribution of mesons from targets subjected to the $\gamma$-ray beam of the synchrotron.

3181 Nuclear and Electronic Paramagnetism and Low Temperature Studies (Third Annual Progress Report). F. G. Dunnington. Rutgers University, Sept. 1, 1949. 26p. (AEC File No. NP-1191.)

Nuclear Magnetic Resonance Studies. A pulse method described previously for the observation of nuclear magnetic resonance has been developed considerably, both experimentally and theoretically. The theory has been improved to take into account (a) the effect of thermal relaxation during the pulse and (b) the effects of inhomogeneities in the steady magnetic field and in the radiofrequency magnetic field. Experimentally the pulse method has been applied to the following proton containing liquids and solids: distilled water and glycerine at room temperature and recently to methane, HCl, and $H_2S$ at temperatures between 90 and 160°K.

Electronic Paramagnetism. The work of the past year has been a continuation of the investigation of the resonance absorption by single-crystal paramagnetic salts at 9375 mc/sec. These measurements give information on (1) the nature of the crystalline electric field surrounding the paramagnetic ion, (2) the magnitude of the splitting of the ground state produced by this field, (3) the "effective g-value" of the paramagnetic ion, (4) the interactions which produce the line width, and (5) the relaxation times associated with these interactions. The way in which these characteristics of paramagnetic salts vary with temperature and dilution is of particular interest. The work at room temperatures on the potassium and ammonium chromium alum salts in undiluted and diluted forms has been completed. (Whitmer et al, Phys. Rev. 74, 1478 (1948)). During the past year measurements have been completed at room temperature on single crystals of iron ammonium alum and samples in three dilutions of this salt. Techniques for making absorption measurements down to the temperature of liquid air have been developed and preliminary results on the chrome and iron alum salts obtained. Apparatus for the study of extremely dilute salts involving a magnetic-field modulation scheme is being developed.

Low Temperature Studies. Work on the following topics is briefly reported: rectification phenomena; wave form study of a-c phenomena in the intermediate state; susceptibility studies in the intermediate state; resistance of gold; helium depth gauges; density of liquid helium.

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Theoretical Studies. Some calculations have been made on paramagnetic copper salts to determine the effects of the electron-nuclear interaction on the electronic resonance absorption spectrum. The interaction consists of two parts: (1) coupling of the nuclear magnetic moment and the orbital motion of the electron, (2) direct coupling of the nuclear magnetic moment and the magnetic moment of the electron by virtue of its spin. Both parts involve the magnetic moment of the nucleus which, in turn, involves the nuclear spin and the nuclear gyromagnetic ratio. It turns out that both these quantities can be determined readily and perhaps with greater precision by electronic absorption than by usual spectroscopic methods.

40-Kw Magnet Stabilizer. The magnet current stabilizer has been in successful operation for 6 months, controlling the current with an accuracy which is comfortably better than the minimum requirements set for it. The short period fluctuations, those of frequencies greater than 0.001 cycle per second, are less than one part in five million. The long period drifts are determined by the stability of the standard resistors and the potentiometer. Rough calculations of the order of magnitude of the thermal drifts to be expected from these two units indicate a drift rate of less than 1 ppm/min after suitable warmup. If smaller drift is ever required, it can be achieved by thermostating.

3182 Nuclear Energy Levels in Sulfur. R. E. Peterson, R. K. Adair, H. H. Barschall, and C. K. Bockelman. AECU-728, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

The total neutron cross section of sulfur has been measured for neutron energies in the range 15 to 750 kev. Neutron energy spreads of from 4 to 9 kev were used in making a survey of the variation of cross section with neutron energy; certain energy regions were later reinvestigated with an energy resolution of from 1.5 to 3 kev. Nine maxima in the cross section were observed in the energy interval studied. These are attributed to the effect of energy levels in $S^{33}$ producing resonances in the elastic scattering. Maxima observed at 111, 375, and 700 kev are preceded by minima presumably caused by interference between resonance and potential scattering (R. K. Adair, et al., Phys. Rev. 76, 308 (1949)); s-neutrons should be responsible for these resonances. P-neutrons, yielding compound nuclei of spin $3\hbar/2$, probably cause a resonance observed at 585 kev. The remaining maxima are believed to be due to neutrons of 1 unit of angular momentum also. Natural widths of the resonances at 111, 375, 585, and 700 kev are estimated to be 18, 12, 1.5, and 12 kev, respectively. (auth)

3183 Interpretation by Means of a Model of the Magic Numbers in Nuclear Structure. J. Hans, D. Jensen, Hans E. Suess, and Otto Haxel. Naturwissenschaften 36, 155-6(1949)(Brief report, in German).

The nucleon shell structure of atomic nuclei proposed by the authors (Naturwissenschaften 35, 376(1948); 36, 153(1949)) is shown to be explainable in terms of an oscillator model by assuming that the interaction between the nucleon added last to the nucleus and the other nucleons can be approximately described by the potential of an isotropic oscillator. The term scheme thus obtained differs only slightly from that obtained empirically. The authors discuss to what extent

these small discrepancies may be due to lack of exact experimental results concerning the properties of atomic nuclei.

3184 Nuclear Configurations in the Spin-Orbit Coupling Model. I. Empirical Evidence. Maria Goeppert Mayer. Phys. Rev. 78, 16-21(1950) Apr. 1.

An extreme one-particle model of the nucleus is proposed. The model is based on the succession of energy levels of a single particle in a potential between that of a three-dimensional harmonic oscillator and a square well. (1) Strong spin orbit coupling leading to inverted doublets is assumed. (2) An even number of identical nucleons are assumed to couple to zero angular momentum and (3) an odd number to the angular momentum of the single odd particle. (4) A (negative) pairing energy, increasing with the j value of the orbit is assumed. With these four assumptions, all but 2 of the 64 known spins of odd nuclei are satisfactorily explained, and all but 1 of the 46 known magnetic moments. The two spin discrepancies are probably due to failure of rule (3). The magnetic moments of the five known odd-odd nuclei are also in agreement with the model. The existence, and region in the periodic table, of nuclear isomerism is correctly predicted. (auth)

3185 The Nucleon Magnetic Moment in Meson Pair Theories. J. Leite Lopes. Phys. Rev. 78, 36-9 (1950) Apr. 1.

The contribution to the nucleon magnetic moment from an interaction of the nucleon with a spinor or scalar meson pair field is calculated. In both cases it is found to be logarithmically divergent. (auth)

3186 On the Interpretation of the Magic Nucleon Numbers in the Structure of Atomic Nuclei. Hans E. Suess, Otto Haxel, and J. Hans D. Jensen. Naturwissenschaften 36, 153-5(1949)(Brief note, in German).

An earlier paper by the authors explained the magic nucleon numbers by a scheme in which the states of the individual protons and neutrons were arranged according to their total angular momenta (Naturwissenschaften 35, 376(1948)). Here the ramifications of this scheme are explored with respect to the assignment of nuclear spins and magnetic moments and the frequent abundance of isomerism for nucleons numbers 40, 70, and 112.

3187 On the Problem of Nuclear Structure: the $N_{10}P_8$ - Model. O. Monecke. Experientia 6, 51-2(1950) Feb. (Brief report, in German).

According to Niggli (Die leichtflüssigen Bestandteile im Magma, Leipzig, 1920) and Sonder (Z. Krist. 57, 611(1923)) the elements of great abundance are characterized by a constant difference of atomic number $\Delta z = 6$. It is shown that this rule can be interpreted as a structure effect when the isotopes are divided into groups and families. For the family with $m = 4n$, where m is the mass number and n an integer, one has to assume that the nuclei belonging to it are composed only of $N_{10}P_8$- and $N_2P_2$-bodies. The latter incline to duplication, so that even numbers of $N_2P_2$-bodies give the nucleus increased stability. (auth)

3188 A Statistical Model of Nuclear Shells. D. Ivanenko and V. Rodichev. Doklady Akad. Nauk S. S. S. R. 70, 605-8(1950)(in Russian).



Several authors, following various lines of reasoning, have pointed out that, in a nucleus, groups of neutrons and protons containing 2, 8, 10, 20, 50, 82, 126 particles must form certain closed shells analogous to the electron shells in atoms of noble gases. Most of those writers have adopted the level sequence $(1s)^2(2p)^6(2s)^2(3d)^{10}$... corresponding to nuclei of $He^4$, $O^{16}$, $Ne^{20}$, $Ca^{40}$, etc. The present authors show that the problem can be approached by applying the statistical method of Thomas and Fermi. In the two equations written, respectively, for the scalar potential of the nuclear forces of attraction and the potential of the electrostatic forces of repulsion, the neutron and proton densities can, by using the statistical method, be expressed as functions of the above potentials. We have then a system of two nonlinear differential equations for whose solution certain boundary conditions are introduced which follow from the continuity requirement. The result of a numerical integration is substituted into an expression for the number $\Delta N$ of neutrons (or protons) in a nucleus whose orbital angular momentum in a certain direction is comprised within the interval $hl/2\pi$, and $h\Delta l/2\pi$, with $\Delta l = 1$. The integration yields $\Delta N$ as a function of l, and also the numbers of neutrons (or protons) which complete the successive nuclear levels. These numbers are 2, 10, 28, 60, 110, with a succession $(1s)^2(2p)^6(2s)^2(3d)^{10}(3p)^6(3s)^2$.... The authors emphasize (1) the statistical character of the result which does not account for individual peculiarities of nuclei and (2) the fact that the nuclear forces were assumed to be of the simplest kind.

3189 Term Displacements in Hydrogen-Like Atoms and the Anomalous Magnetic Moment of the Electron. Ya. A. Smorodinskiĭ. Uspekhi Fiz. Nauk 39, 325-58 (1949)(in Russian).

This is a review of the literature on the theory of the term displacements of hydrogen-like atoms (34 references). First the nonrelativistic, then the relativistic, aspects of the theory are examined, the latter introducing the anomaly of the electron's magnetic moment as one of the effects of the interaction between the electron and the vacuum field. Other possible effects that could admit of an evaluation are mentioned, and the problem of the hyperfine structure of deuterium is outlined.

3190 Engineering Aspects of Nuclear Reactors. III. L. A. Ohlinger. Nucleonics 6, 54-63(1950) Feb. (See also NSA 4-1537; 4-2061.)

The author gives construction details for homogeneous and heterogeneous reactors, discussing the design of cooling systems, reflectors, and shields. He describes the various possible distributions of fuel in heterogeneous piles, the different types of mechanisms that may be used to control the level of operation, and the provisions which must be made to remove and reprocess this fuel. This must be done periodically, at time intervals whose length depends on several factors. The influence of these factors on the operating life of the pile is discussed.

3191 Engineering Aspects of Nuclear Reactors. IV. L. A. Ohlinger. Nucleonics 6, 46-57(1950) Mar. (See also NSA 4-1537; 4-2061.)

Nuclear power plants are considered here as a whole. Application of pile heat to gas turbines, ramjets, and rockets is discussed in relation to the whole system. Limitation on

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use of nuclear energy because of fuel scarcity is also discussed in detail. (auth)

3192 Pile Neutron Research Techniques. 1. D. J. Hughes. Nucleonics 6, 5-17(1950) Feb.

The author discusses the design and operating characteristics of the five chain-reacting piles now running in the U. S. The central neutron flux values for these piles are tabulated, and the facilities for utilizing the pile neutrons, both inside and outside the pile, are described. Methods for producing collimated, monochromatic neutron beams in the low, high, and intermediate energy ranges and methods of measuring the intensities of such beams are outlined. An extensive bibliography is included.

3193 Protons from the Deuteron Bombardment of Separated Neon Isotopes. A. Zucker and W. W. Watson. NYO-668, Mar. 7, 1950. 8p.

With neon gas enriched either to 93% $Ne^{22}$ or to 99% $Ne^{20}$, confirmation of the observations with isotopes of lower concentration by Elder, et al. (Phys. Rev. 71, 917(1947)) has been obtained on the $Ne^{22}(d,p)Ne^{23}$ and $Ne^{20}(d,p)Ne^{21}$ reactions. Aided by the enrichment factor of 3 for $Ne^{21}$ in the "heavy" neon, a long-range proton group has been found from $Ne^{21}(d,p)Ne^{22}$ with a Q of 7.00 ± 0.10 Mev for the reaction. Consideration of these and other reactions involving neon isotopes show that the mass of $Ne^{21}$ is 21.00062 ± 0.00010 and that this new proton group indicates an excited state at 1.37 Mev in the $Ne^{22}$ nucleus. (auth)

3194 The Angular Distribution of Gamma-Rays from $^7Li(p,p')^7Li^*$. R. M. Littauer. Proc. Phys. Soc. (London) 63A, 294(1950) Mar. 1 (Letter to the editor).

The angular distribution of $\gamma$ radiation from the reaction $Li^7(p,p')Li^{7*}$ was measured by means of scintillation counters. The bombarding energies on the thin $Li_2CO_3$ target ranged from the effective threshold value (800 kev) to 1,080 kev. Under these conditions the contribution to the counting rates from the 17-Mev $\gamma$ ray due to $Li^7(p,\gamma)Be^8$ was negligible. The angular distribution was fitted to the curve $I(\theta) = I_0(1 + A \cos \theta)$, with A = 0.016. The experimental points fit the curve well so that the upper limit of any undetected anisotropy can be placed at A = 0.005. From the observed isotropy the author concludes that the spin of $Li^{7*}$ is ½.

3195 Photo-Neutron Thresholds of Titanium[46] and Chromium[50]. W. E. Ogle and R. E. England. Phys. Rev. 78, 63(1950) Apr. 1 (Letter to the editor).

The photoneutron thresholds of $Ti^{46}$ and $Cr^{50}$ have been measured, using the 20-Mev betatron at Los Alamos. The threshold values were determined by comparing the observed thresholds with the threshold of $Cu^{63}$, where the threshold for the $Cu^{63}(\gamma,n)Cu^{62}$ reaction was taken as 10.85 Mev. In both cases it was possible to irradiate the element under investigation and to observe the resultant activity. The total irradiation was in each case measured by means of an integrator circuit employing a photomultiplier phosphor combination and a standard current integrating circuit. The data taken during this work indicate that the threshold for the $Ti^{46}(\gamma,n)Ti^{45}$ reaction is 13.3 ± 0.2 Mev and that the threshold for the $Cr^{50}(\gamma,n)Cr^{49}$ reaction is 13.4 ± 0.2 Mev.

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3196 Protons form the Deuteron Bombardment of Separated Neon Isotopes. A. Zucker and W. W. Watson. Phys. Rev. 78, 14-15(1950) Apr. 1.

With neon gas enriched either to 93% $Ne^{22}$ or to 99% $Ne^{20}$ the authors confirm the observations with less well-concentrated isotopes by Elder, Motz, and Davison (Phys. Rev. 71, 917(1947)) on the $Ne^{20}(d,p)Ne^{21}$ and $Ne^{22}(d,p)Ne^{23}$ reactions. Aided by the enrichment factor of 3 for $Ne^{21}$ in the "heavy" neon, the authors find a long-range proton group from $Ne^{21}(d,p)Ne^{22}$ with a Q of 6.79 ± 0.10 Mev for the reaction. Consideration of these and other reactions involving neon isotopes shows that the mass of $Ne^{21}$ is 21.00062 ± 0.00010 and that this new proton group indicates an excited state at 1.37 Mev in the $Ne^{22}$ nucleus. (auth)

3197 A New Method for Particle Injection into Accelerators. W. B. Jones, H. R. Kratz, J. L. Lawson, G. L. Ragan, and H. G. Voorhies. Phys. Rev. 78, 60-2 (1950) Apr. 1.

This paper describes a new method of injecting particles into a betatron, a method which has been successfully used in the betatron phase of the operation of the nonferromagnetic synchrotron now under construction at the General Electric Research Laboratory. In the usual type of synchrotron, many factors operate to prevent the electron beam from hitting the injector apparatus, but in this new instrument it was found necessary to make special provisions to eliminate this difficulty. The scheme which is being used involves two steps; first, a means is provided for rapidly damping the radial or vertical oscillations for as many revolutions as possible, and then this damping agent must be removed before it can cause subsequent undamping. This is accomplished by proper control of the azimuthal variation of the index n, and by reducing this azimuthal variation to zero some time late in the gun injection pulse.

3198 On the Theory of the Acceleration of an Electron in a Magnetic Alternating Field. II. (Contribution to the Theory of the Rheotron or Betatron). J. Picht. Optik 6, 61-97(1950) Feb. (in German). (See also NSA 4-2792.)

This is a continuation of an earlier paper (Optik 6, 40 (1950)) on the theory of the betatron. The topics discussed here include the effect of the superposition of two periodic magnetic fields with the same frequency, the superposition of a periodic and a constant magnetic field, the formulation of the stability conditions, using the customary technical units of the electromagnetic field, and investigations of the possibility of focusing the electrons emitted from the electron source in various directions. All calculations are carried out in detail, and tables of numerical results are given.

3199 The Use of Cloud Chambers with Pulsed Accelerators. Evans Hayward. Science 111, 349-55(1950) Apr. 7.

The author discusses the principles of operation of the cloud chamber and its function in nuclear research. The pulsed operation of the cloud chamber, in conjunction with particle accelerators delivering pulses of particles, has several advantages. Probably the greatest advantage of this type of operation is the fact that the expansion of the chamber may be started before the arrival of the particles. The par-

ticles enter the chamber after the expansion is complete, at a time when the turbulence due to the expansion has disappeared and before convection currents become strong, so that the tracks which they produce are very sharp. Several photographs, showing stars produced by neutrons, meson disintegrations, and penetrating showers, are reproduced.

3200 Yield of $He^3$ and Scattered Protons from $Li^6$ + P. S. Bashkin, F. Ajzenberg, C. P. Browne, Gerson Goldhaber, M. J. W. Laubenstein, and H. T. Richards. AECU-727, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

Ordinary lithium targets (10 to 50 kev thick) evaporated on 1/30- and 1/50-mil thick nickel foils have been bombarded by monochromatic protons with energies from 0.440 to 3.5 Mev. Particles at 164 deg to the beam were observed with a 90 deg magnetic analyzer having 2% momentum resolution. This resolution plus pulse height discrimination in a thin-window proportional counter permitted identification of protons scattered from $Li^6$, $Li^7$, $C^{12}$, $O^{16}$, and the nickel foil, and $He^3$ particles from $Li^6(p,\alpha)He^3$. Elastically scattered protons from $Li^6$ showed an asymmetric resonance (450-kev width at half-maximum) at $E_p$ = 1.8 Mev. The $He^3$ particles showed a similarly broad resonance, but with the maximum at $E_p$ = 1.9 Mev. These resonances indicate a level in $Be^7$ at 7.1 Mev, probably corresponding to the 7.38-Mev state of the mirror nucleus, $Li^7$. The $He^3$ yield was observed down to $E_p$ = 0.440 Mev, but resolution problems limited the low-energy proton observations to $E_p$ = 850 kev. There is some indication from the low-energy $He^3$ and scattered proton data of another resonance at low proton energy.

3201 Yield of Scattered Protons from $Li^7$. H. T. Richards, S. Bashkin, D. S. Craig, D. Donahue, V. R. Johnson, and D. Martin. AECU-730, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

The method and equipment described in the foregoing abstract [AECU-727] were used to examine the yield at 164 deg of elastically and inelastically scattered protons from $Li^7$ for proton energies up to about 3.5 Mev. The elastically scattered protons could only be resolved satisfactorily for $E_p$ > 850 kev. The well-known resonance at $E_p$ = 1.05 Mev was observed, but no other structure was detected below $E_p$ = 1.87 Mev. A weak maximum (30 kev wide at half-maximum) occurred at this energy. This level, which is below the threshold for neutron emission, may be that suggested by Breit and Bloch (Phys. Rev. 74, 397(1948)) to explain the observed neutron yield from $Li^7(p,n)Be^7$. An intense and broad maximum is observed at $E_p \approx 2.06$ Mev. After passing through a minimum at $E_p \approx 2.25$ Mev, there is a rise until $E_p$ = 2.5 Mev, above which the yield is almost constant. The inelastically scattered protons could only get through the counter window for $E_p$ > 1.5 Mev. No structure was observed in the inelastic scattering yield up to $E_p$ = 3.5 Mev. (auth)

3202 Self-Absorption and Backscattering of Beta Radiations. L. E. Glendenin and A. K. Solomon. AECU-735, nd. 20p.

An investigation has been made into the effects of self-absorption (thick source), backscattering by container or backing material (thin source), and selfscattering (internal scattering by the source) on the counting of $\beta$ particles from low-energy emitters such as $S^{35}$, $Ca^{45}$, and $P^{32}$, commonly used in biological work. The effects of backscattering and selfscattering were found to be strongly dependent on the atomic number of the scattering material; these effects increase as the atomic number increases.

3203 The Scattering of Protons by Protons Near 30 Mev. I. Photographic Method. Wolfgang K. H. Panofsky and Franklin L. Fillmore. UCRL-481, Jan. 23, 1950. 55p.

The scattering of 29.4-Mev protons by hydrogen gas at 1 atm has been studied, using the beam of the Berkeley linear accelerator. The beam, collimated to a diameter of 1/16 in., passes through the gas and constitutes a line source of scattered protons. The scattering angle of the scattered protons is measured directly in the emulsion of 50 $\mu$ Ilford C-2 emulsions. Measurements of the range of the scattered protons was made on a fraction of the tracks. From range-energy relations established in the magnetic field of the 184-in. cyclotron for the emulsions used, the primary energy of the protons before scattering was found to be 29.4 ± 0.1 Mev. Protons were observed in the angular range 10 deg $\leq \theta$ lab $\leq$ 80 deg; two independent sets of scattering data in the angular region greater or less than 45 deg are thus obtained; a valuable internal check on observational errors or background or impurity effects is thus possible. No statistically significant difference in the two regions was observed. 10,934 tracks have been tabulated; this results in the statistical error approximately matching systematic errors such as those due to tolerance of plate geometry, observational error, etc. Cross sections obtained are absolute; the beam is measured by absorption in a Faraday cup and charge integration on a low-leakage condenser. The most significant result of these experiments is the apparent absence of expected repulsive P wave and of D wave effects. 27 references. (auth)

3204 Proton-Proton Scattering in Charged Scaler Theory. K. A. Brueckner and K. M. Watson. UCRL-606, Feb. 21, 1950. 6p.

Recent measurements at Berkeley (Christian, Bull. Am. Phys. Soc. 24, No. 8, (1949)) of 345-Mev proton-proton and 280-Mev neutron-proton scattering have shown a remarkable difference in the two types of scattering. The neutron-proton scattering has a cross section of 36 millibarns and is very strongly peaked at 0 and 180 deg in the center-of-mass system; the proton-proton scattering has a much larger differential cross section at 90 deg and is nearly isotropic in the angular range 20 to 160 deg. In an attempt at a qualitative explanation of these experimental differences, calculations have been made of the neutron-proton and proton-proton scattering to 4th order in the meson-nucleon coupling, using charged scalar theory. The agreement between theory and experimental results proved unsatisfactory.

3205 The Correction of Specific $\beta$-Radioactivity for Self-Absorption. C. H. Collie, P. F. D. Shaw, and H. J. Gale. Proc. Phys. Soc. (London) 63A, 282-90(1950) Mar. 1.

The self-absorption of $\beta$ rays in radioactive films between 5 and 100 mg/cm$^2$ superficial density has been investigated.

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The marked departures from the exponential absorption law are shown to be due to scattering of the $\beta$ rays in the film. The use of very thin films to avoid the correction for self-absorption is not recommended as a routine method. (auth)

3206 The Range-Energy Curves for Alpha-Particles and Protons. William P. Jesse and John Sadauskis. Phys. Rev. 78, 1-8(1950) Apr. 1. (See also NSA 2-2161.)

Previous experiments have shown that in argon there exists a very good proportionality between the energy of an $\alpha$ particle and the total ionization produced by it. In air this proportionality is not found, the ionization decreasing more rapidly than energy at low $\alpha$ energies. Range-energy curves are determined in the region 0 to 5 Mev, where the ionization in air is used as a measure of the $\alpha$ energy, hence they give too low energy values. Such curves, when corrected to equivalent ionization values in argon, show much better agreement with range and energy data derived from nuclear reactions. The range-energy curve for protons, derived from the $\alpha$ curve, also shows improved agreement with nuclear data when the corrected $\alpha$ range-energy curve is substituted for the old. (auth)

3207 Tables for Determining Reduction of Energy and Intensity of X-rays and Gamma-Rays at Various Scattering Angles in Small Thicknesses of Matter. G. Allen. National Advisory Committee for Aeronautics, Technical Note 2026, 1-45(1950) Feb.

Tables are presented for determining the total-absorption coefficients as well as the intensities and spectral distribution of $\gamma$ rays at any given scattering angle. Only thin scatterers are treated, and secondary effects are neglected. Included are both experimental and computed data on $\gamma$ rays of quantum energies up to 20 Mev for all elements for which significant data are available. Published, experimentally verified data on total-absorption coefficients have been used wherever possible. In those energy regions for which such data are still lacking, values of photoelectric, Compton, and pair-formation coefficients were computed, using the formulas of Hall and Klein-Nishina and interpolating from the Bethe-Heitler formula, respectively. Examples are included to illustrate the use of the tables. (auth)

3208 A Verification of the Formula of Klein and Nishina at 2.62 Mev. M. Ageno, M. Chiozzotto, and R. Querzoli. Rend. ist. super. sanità 12, 279-87(1949) (in Italian).

A similar article has appeared in Atti accad. nazl. Lincei 4, 319(1949). An abstract of that article has appeared in Nuclear Science Abstracts as No. 4-849.

3209 The Ionization in Argon and in Air by Single Alpha-Particles as a Function of Their Energy. William P. Jesse, Harold Forstat, and John Sadauskis. Phys. Rev. 77, 782-6(1950) Mar. 15. (See also NSA 2-2161.)

An extended series of measurements has been made to determine the possible variation of W, the energy to make an ion pair in pure argon, with the energy of the ionizing $\alpha$ particle. The ionization in argon relative to the ionization produced by a comparison polonium $\alpha$ has been measured for the $\alpha$ emitters $Ra^{224}$, $Bi^{212}$, $Po^{218}$, $Po^{214}$, $Po^{212}$. For $\alpha$ particles in this energy region from 5 to 9 Mev, no deviation of W from the average W for the polonium $\alpha$ could be found amounting to as much as 0.5%. This is in marked contrast to the $\alpha$ ionization in air from the work of Stetter. More indirect measurements in the region 1 to 5 Mev indicate no measurable change in W for $\alpha$ particles in argon, while values derived from the Stetter curve for air show a marked increase of W as zero $\alpha$ energy is approached. Evidence from direct measurements is given to show that the energy to make an ion pair in argon for the $Li^{7*}$ ion emitted from the reaction $B^{10}(n,\alpha)Li^{7*}$ is apparently the same as the average for the polonium $\alpha$ particle. (auth)

3210 Extension of Alpha- and Beta-Decay Systematics of Protactinium Isotopes. W. Wayne Meinke and Glenn T. Seaborg. AECD-2812, Jan. 30, 1950. Decl. Mar. 27, 1950. 7p.

Some pertinent new measurements are reported for protactinium isotopes, obtained by low-energy deuteron and proton bombardments of natural uranium. The protactinium was chemically separated by a procedure which involved a number of manganese dioxide cycles coupled with extractions of protactinium from aqueous into organic solvents. The protactinium from the 19-Mev deuteron bombardment contained 23.7 ± 0.5 min and 27-day $\beta$-particle emitters. The 23.7-min activity was assigned to $Pa^{236}$, and the 27-day activity was assigned to $Pa^{233}$. The 23.7-min activity was also found in the protactinium fraction from the bombardment of natural uranium with 9.5-Mev protons. A partial half-life for $\alpha$-particle emission of about 1,400 years ±20% was found for $Pa^{230}$ obtained by 60-Mev deuteron bombardment of a thick thorium target. This half-life was inferred by measuring the equilibrium amount of the $Pa^{230}$ $\alpha$-disintegration product, the $\beta$-particle emitting 29-hr $Ac^{230}$.

3211 Radiations of $Zr^{97}$ and $Nb^{97}$. W. H. Burgus, J. D. Knight, and R. J. Prestwood. AECU-726, nd. 19p.

The radiations of $Zr^{97}$ and $Nb^{97}$ have been examined by $\beta$-ray spectrometry and coincidence counting. The 17.0-hr $Zr^{97}$ has been found to decay to a 60-sec isomer of $Nb^{97}$, the latter undergoing isomeric transition to the 75-min $Nb^{97}$ ground state. The disintegration energies are: $Zr^{97}$, $E_\beta$ = 1.91 ± 0.02 Mev; $Nb^{97m}$, $E_\gamma$ = 0.747 ± 0.005 Mev; $Nb^{97}$, $E_\beta$ = 1.267 ± 0.02 Mev; $E_\gamma$ = 0.665 ± 0.005 Mev. A procedure for isolation of fission product $Zr^{97}$ is appended.

3212 Additional Electron Lines from Radioactive Europium. J. M. Cork, H. B. Keller, W. C. Rutledge, and A. E. Stoddard. Phys. Rev. 77, 848-9(1950) Mar. 15 (Letter to the editor).

Previous investigations (Shull, Phys. Rev. 74, 917(1948); Hayden et al, ibid., 75, 1500(1949)) have shown many internally converted $\gamma$ rays to be emitted by activated europium. The K-L-M differences observed for many of the electron lines are characteristic of gadolinium (Z = 64), as would be expected for $\gamma$ rays following $\beta$ emission from europium (Z = 63). For other lines, the K-L-M differences are characteristic of samarium (Z = 62). The samarium results from the K-capture process in europium 152, which also decays by $\beta$ emission. In the present investigation with photographic magnetic spectrometers, the neutron-activated long-lived europium was found to emit 33 electron lines, whose energies and probable origins are tabulated.

Of these, about 26 lines may be uniquely identified as samarium or gadolinium lines. The corresponding $\gamma$-ray energies are also tabulated. The remaining lines are of uncertain origin. The author proposes a decay scheme for europium.

3213 Angular Correlation between Short-Range $\alpha$ Particles and $\gamma$ Quanta. L. A. Kul'chitskiĭ, G. D. Latyshev, and D. G. Bulyginskiĭ. Izvest. Akad. Nauk S.S.S.R. Ser. Fiz. 13, 331-9(1949)(in Russian).

This is an amplified version of an article which appeared in Doklady Akad. Nauk. S.S.S.R. 64, 57(1949) and was abstracted in Nuclear Science Abstracts as No. 4-856.

3214 The Application of Brønsted's Method of Isotope Separation to the Study of the Natural Radioactivity of Potassium. G. Hevesy. Acta Chem. Scand. 3, 1263-8(1949).

This article is a review of the various experimental studies of the radioactivity of potassium which have been made with the aid of Brønsted's method of separation. This method involves a distillation or effusion process. A combination of the two types of processes was used by early workers to produce potassium enriched in $K^{41}$. By comparing the percentage of enrichment with the change in activity, it was concluded that the isotope responsible for the activity was not $K^{39}$ or $K^{41}$, but $K^{40}$. Mass-spectroscopic methods, more accurate than those available to the original investigators, later showed that the percentage of enrichment of $K^{40}$ and the percentage change in activity were almost the same, corroborating this conclusion.

3215 $\beta$ Spectrum of $Ho^{166}$. N. M. Anton'eva, A. A. Bashilov, B. S. Dzhelepov, and A. V. Zolotavin. Doklady Akad. Nauk S.S.S.R. 70, 397-400(1950) (in Russian).

$\beta$ spectrum of $Ho^{166}$ (27.5 $\pm$ 0.5 hr), obtained from neutron-irradiated $Ho_2O_3$, showed a continuous part with an energy limit 1,840 kev and an intensive group of slow electrons with energies less than 100 kev. This latter group had a weak maximum at about 21 kev and two strong maxima at 68.4 $\pm$ 0.3 and 75.6 $\pm$ 0.3 kev; they were attributed to internal conversions on the K, L, and M levels of $Er^{166}$, the energy of the corresponding $\gamma$ quantum being probably 81 $\pm$ 1 kev. Since the conversion coefficient seems to be very high, there is a possibility of an isomeric transformation of $Ho^{166}$. However, preliminary tests with a coincidence arrangement having a 0.3-$\mu$sec resolving power showed the presence of many coincidences; this ruled out the isomer hypothesis and confirmed the picture of a $\gamma$ conversion following a $\beta$ decay. Besides electrons, $Ho^{166}$ emits $\gamma$ rays of about 1.5 Mev; no conversion electrons of that energy were observed.

3216 $\beta$ Spectrum of $Lu^{177}$. N. M. Anton'eva, A. A. Bashilov, B. S. Dzhelepov, and A. V. Zolotavin. Doklady Akad. Nauk S.S.S.R. 70, 597-9(1950)(in Russian).

The irradiation of lutecium with slow neutrons results in the formation of two Lu isotopes whose half-life periods are 3.67 hr and 6.7 days. The $\beta$ spectrum of the latter, which belongs to $Lu^{177}$, was investigated here. The source was $Lu_2O_3$; the instrument was an improved magnetic



spectrometer which has been used by the authors in similar works (Dzhelepov et al, Doklady Akad. Nauk S.S.S.R. 64, 803(1949); Anton'eva et al, ibid. 70, 397(1950)). The limit of the spectrum is at 475 $\pm$ 5 kev; four conversion maxima are at 44.0, 98.0, 106.5, and 137 kev. Since the differences between the first three of the latter are equal to differences K$-$L and L$-$M of Hf, the three maxima are ascribed to an internal conversion of a 112 $\pm$ 1 kev $\gamma$ ray on the K, L, and M shells of Hf, the ratios of the conversion coefficients being approximately 1:2:0.5. The fourth maximum corresponds presumably to a conversion of a $\gamma$ ray of 204.5 kev energy on the L level of Hf. This is probably the 200-kev radiation which has been observed by Bothe (Z. Naturforsch. 1, 179(1946)).

3217 The Capture of Peripheral Electrons. Theoretical Aspect and Experimental Facts. P. Benoist and R. Bouchez. Rev. optique 1949, 103-52 (in French).

This is a review of the theory of orbital capture and positron emission and a short treatise on experimental procedures and results. As the authors conclude, the theoretical study of capture is still, with rare exceptions, in the descriptive stage.

3218 The Disintegration of $Sb^{125}$ and $Te^{125*}$. Kai Siegbahn and Wilhelm Forsling. Arkiv Fysik 1, No. 24, 505-13(1949).

A study is made of the decay of $Sb^{125}$ and its daughter $Te^{125*}$, as obtained from neutron-irradiated tin. Analysis of the $\gamma$ radiation from $Sb^{125}$ (using the photoelectrons from Pb) gives energies of 35, 110, 175, 425, 465, 601, and 637 kev. The $\beta$ spectrum contains internal conversion lines, corresponding to those found in the $\gamma$ spectrum, together with one additional electron line, interpreted as an Auger line. The continuous spectrum has been resolved into three different $\beta$ components, namely $E_{\beta_1}$ = 128 kev, $E_{\beta_2}$ = 299 kev, $E_{\beta_3}$ = 616 kev, with relative intensities 33, 49, and 18%. The internal conversion spectrum emitted from $Te^{125*}$ has been investigated. The K:(L + M) ratio of the 110-kev transition is 1.10. Besides these lines, two other lines have been found. One of them is a conversion line from the L shell, the corresponding $\gamma$ energy being 35 kev; and one is an Auger electron line, showing a transition K-L-$L^1$. A term scheme is proposed, and it seems probable that the three $\beta$ components are (with increasing energy) 1st forbidden, 2d forbidden, and 3d forbidden.

3219 Disintegration of $Te^{121}$ and $Te^{123}$ Isomers. Robert Katz, R. D. Hill, and M. Goldhaber. Phys. Rev. 78, 9-11(1950) Apr. 1.

Line intensities in the conversion electron spectra of $Te^{121}$ and $Te^{123}$ were evaluated in a variable-field 180-deg focusing $\beta$-ray spectrograph. Electron-electron coincidences were obtained between the transition pairs 82 to 213 kev in $Te^{121}$ and 88.5 to 159 kev in $Te^{123}$. Decay schemes for the two isomers are shown. (auth)

3220 Excited States of Nuclei. S. Devons. Cambridge, University Press, 1949. 152p.

This monograph is written primarily from the experimental standpoint, describing the technique and scope of recent research on excited states of nuclei. Theoretical results are summarized without detailed explanation. The individual topics dealt with are the excitation of bound states, the

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excitation of "virtual" states, radiative transitions, and the interpretation of nuclear spectra. An extensive bibliography contains 143 references which include the literature up to the end of 1948.

3221 Measurement of Actinium. M. Lecoin, M. Perey, and A. Pompeï. J. Chim. Phys. 46, 158-67(1949) (in French).

The authors describe procedures used in the Laboratoire Curie for measuring a quantity of Ac or of Ac-disintegration products by means of either the $\beta$ or the $\gamma$ radiation. By $\alpha$-ray measurements and calorimetric determinations, they have established the correspondence between the $\beta$ and $\gamma$ measurements, obtained under specific conditions, and the quantity of the source in millicuries.

3222 The Neutrino and the Recoil of Nuclei in $\beta$-Disintegrations. B. Pontecorvo. Reports on Progress in Physics (Phys. Soc. of London) 11, 32-42(1948).

An account is given of those aspects of nuclear recoil which have a direct bearing on the neutrino hypothesis. The experiments cited give circumstantial evidence of neutrino emission by showing a disparity between the energy and linear momentum of the $\beta$ particle and those of the recoil nucleus. They have not, however, been sufficiently precise to find the neutrino mass. It seems that direct evidence of neutrino existence cannot be obtained from recoil experiments, but must come from detection of some neutrino-produced effect such as an inverse $\beta$ process.

3223 On the Isomerism of $Kr^{83}$. I. Bergström, S. Thulin, and G. Andersson. Phys. Rev. 77, 851-2(1950) Mar. 15 (Letter to the editor).

By separating the gaseous fission products of uranium (after cyclotron bombardment) in the electromagnetic isotope separator of the Nobel Institute, it has been possible to obtain $Kr^{83}$ with an activity sufficient for $\beta$-spectrometer investigations. The $\beta$ spectrograph shows two peaks, corresponding to K and L conversion electrons produced by $\gamma$ rays of 31.5 and 32.5 kev, respectively. The absorption effect of the G-M tube window was calculated from measurements of the $Co^{60}$ spectrum. Other spectrometer measurements yielded a $\gamma$-ray energy of 32.7 ± 0.5 kev, a value obtained from the L line whose position was much more accurately determined than that of the K line. This $\gamma$ probably corresponds to the 29-kev $\gamma$ previously reported by Helmholz (Phys. Rev. 60, 415(1941)), but the other $\gamma$ reported by him was not found.

3224 The Radiations of Praseodymium-142. E. R. Rae. Proc. Phys. Soc. (London) 63A, 292-3(1950) Mar. 1 (Letter to the editor).

The 19.3-hr activity of $Pr^{142}$ from a spectroscopically pure sample of $Pr_2O_3$, irradiated in the Harwell pile, was examined by means of a semicircular magnetic spectrometer of 12 cm radius and geometrical resolution of 2%. The end points of the $\beta$ spectrum for the soft and hard components are 0.66 ± 0.02 Mev and 2.23 ± 0.04 Mev, respectively. The spectrum of the secondary electrons ejected from a thick copper cylinder covered with a thin (0.0015 in.) lead foil by the $\gamma$ rays of $Pr^{142}$ is also given, from which the energy of the $\gamma$ radiation is estimated to be 1.59 ± 0.04 Mev. An energy-level diagram with one intermediate level is suggested for the $\beta$ decay of $Pr^{142}$.

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3225 Radioactivity in Platinum by Neutron Capture. J. M. Cork, A. E. Stoddard, W. C. Rutledge, C. E. Branyan, and J. M. LeBlanc. Phys. Rev. 77, 843 (1950) Mar. 15 (Letter to the editor).

Specimens of pure platinum, irradiated in the Oak Ridge and Argonne piles, yield a complex decay curve which may be resolved into three components whose half-lives are 82 days, 3.4 days, and 17.4 hr. The 82-day activity, previously unreported, is found by absorption in aluminum to have $\beta$ radiation with an upper limit of about 0.54 Mev and by absorption in lead, a $\gamma$ ray of energy about 0.6 Mev. That the activity is in platinum was shown by a chemical separation. Exposures in $\beta$ spectrometers showed that the radioactive platinum emitted more than 20 electron lines, whose energies are tabulated. The K-L-M differences, where observable, are in every case characteristic of mercury, and the activity producing the lines decayed with the half-life of 3.4 days. It is concluded that the activity is due to radioactive $Au^{199}$ derived from $Pt^{199}$ formed by neutron capture in $Pt^{198}$. Since the exposure in the pile was of 2 months duration, the long-lived emitters were very strong compared with the previously reported 17.4-hr activity, but some signs of such an activity were observed.

3226 Recoil Electron Spectrum of the $K^{40}$ Gamma-Ray. R. W. Pringle, S. Standil, and K. I. Roulston. Phys. Rev. 77, 841(1950) Mar. 15 (Letter to the editor).

An accurate determination of the energy of the $K^{40}$ $\gamma$ ray has been made, using a type of scintillation spectrometer developed by the authors (Pringle et al, Rev. Sci. Instruments, in press). The crystal element of activated NaI was surrounded by approximately 90 g of KF, and a plot is given of the recoil electron spectrum obtained after the radiation was filtered with 4 mm of Al. From this plot it is not possible to draw any conclusions as to the possible complexity of the gamma spectrum. The $\gamma$-ray energy turns out to be 1.47 ± 0.03 Mev, so that the energy available for electron capture to the excited state of $A^{40}$ is less than 0.13 ± 0.03 Mev. Coincidence experiments are being carried out to further clarify the decay scheme.

3227 Exchange of Charge between Elementary Particles. J. de Boer. Nederland Tijdschr. Natuurk. 15, 169-75(1949) July (in Dutch).

In an attempt to correlate various types of interaction between elementary particles, it is shown that the physical constant giving a measure of the probability of such processes of interaction is very nearly the same in the three cases: (1) $\beta$ radioactivity, interaction between neutrons and nucleons, electrons and neutrinos ("leptons"); (2) $\mu$-meson decay, between $\mu$ mesons and leptons; (3) $\mu$-meson absorption, between $\mu$ mesons and nucleons.

3228 Interaction Between Elementary Particles. Part II. Alfred Landé. Phys. Rev. 77, 814-16(1950) Mar. 15. (See also NSA 3-2349.)

A particle described by an exact function with shift of origin, rather than by a structural smoothed-out $\delta$ function, has equations of motion derivable from Fokker's least action principle, in analogy to Feynman's work. The two objections of arbitrariness of the structure function and of violation of the linear field equations within the particle radius are there-

by avoided. The relation to Born's new theory of elementary particles is discussed. (auth)

3229 The Linearity of the Electrodynamic Equations of Maxwell. P. Kunze. Naturwissenschaften 36, 356-9(1949)(in German).

This is a review article which describes briefly the attempts to make the equations of electrodynamics nonlinear in order to avoid divergence difficulties. The classical nonlinear theory of Born (Proc. Roy. Soc. (London) 143, 410(1934)) is discussed, as well as the quantum-mechanical treatment of the scattering of light by light of Euler (Ann. Physik 26, 398(1936)) which also leads to nonlinear expressions. Finally, various unsuccessful attempts are mentioned to find such nonlinearities experimentally.

3230 Methods of Integration Common to Classical Mechanics and Wave Mechanics. Robert Faure. Compt. rend. 230, 364-5(1950) Jan. 23 (in French).

The author proves the following theorem: For systems of particles with time-independent potentials, no classical process of integration (of the equations of motion) leading to the introduction of constants may be extended to wave mechanics for the determination of eigenfunctions unless it furnishes a first integral in classical mechanics. This condition is not sufficient. This result is in agreement with conclusions reached by the author in a previous article (Compt. rend. 226, 1506-8(1948)).

3231 Note on the Formalism of Quantized Fields. Jean Pirenne. Physica 15, 1023-31(1949) Dec. (in French).

The object of this article is to present a simple method for obtaining the quantum field operators for fields obeying the Fermi or Bose statistics and to bring out clearly the geometrical significance of the commutation relations. The transition from configuration space to quantum space (in which the quantum numbers are treated as coordinates) is affected by means of a unitary matrix, S, whose structure completely determines the form of these operators. One of the commutation relations follows from the fact that S must furnish a representation of the group of permutations, while the other results from the unitarity of S. (auth)

3232 A Note on the Quantization of Dissipative Systems. Wesley E. Brittin. Phys. Rev. 77, 396-7(1950) Feb. 1.

The work of E. Kanai (Prog. Theor. Phys. 3, 440(1948)) shows that the quantization of dissipative systems by use of a Hamiltonian formalism involving the time explicitly leads to results in disagreement with experience. The author discusses the quantization of dissipative systems in a manner such that the time does not enter explicitly. It is shown that in the Heisenberg representation the only kind of dissipative forces consistent with the formalism are those which are functions of coordinates alone. There exists no Schroedinger representation unless the forces are non-dissipative. (auth)

3233 On a Pseudo-Scalar Theory of Nuclear Forces. Claude Marty and Jacques Prentki. Compt. rend. 230, 50-3(1950) Jan. 2 (in French).

Recently a completely relativistic theory of nuclear forces, based on a pseudo-scalar meson field, has been developed by van Hove (Phys. Rev. 75, 1519(1949)). This theory seems promising since it leads to an interaction potential between nucleons which has a permissible singularity at the origin and might therefore give rise to stationary states in the deuteron. The authors point out, however, that the theory conflicts with the result of neutron-proton scattering experiments at 90 Mev, at least if radiative corrections are not taken into account. It appears that no purely pseudo-scalar theory of nuclear forces can be in agreement with the experimental results to this approximation.

3234 Principle of Spectral Decomposition and Average Values in the Wave Mechanics of the Photon. Serge Slansky. Compt. rend. 230, 275-6(1950) Jan. 16 (in French).

In the wave mechanics of the photon, two different methods are commonly used to get average values of operators, sometimes with conflicting results. The author discusses this discrepency from the point of view of the principle of spectral decomposition and concludes that there is some ambiguity in the normalization procedure used for photon wave functions. The physical causes of this ambiguity are discussed.

3235 On a New Theory of Nuclear Forces. H. J. Bhabha. Phys. Rev. 77, 665-8(1950) Mar. 1.

A new theory of nuclear forces is based on the result established in an earlier paper (Revs. Modern Phys. 21, 451 (1949)) that if the matrix $\alpha^0$ in the field equations $(\alpha^k p_k + \chi)\psi = 0$ satisfies the minimal equation $\left[(\alpha^0)^2 - 1\right]^2 (\alpha^0)^s = 0$ for any integer $s \geq 0$, then every component of the field $\psi$ satisfies the iterated generalized wave equation $(\Box + \chi^2)^2 \psi = 0$ of the fourth order. The static potential between two nucleons is then a sum of an interaction between two point charges and a dipole-dipole interaction multiplied by numerical coefficients and isotopic spin factors. This interaction, unlike the usual one based on the Yukawa theory, allows an exact solution of the deuteron problem. The potentials based on more complicated fields satisfying the n times iterated generalized wave equation are also given. (auth)

3236 On the Scattering of $\pi$ Mesons by Nucleons. Maurice Jean and Jacques Prentki. Compt. rend. 230, 365-7(1950) Jan. 23 (in French).

In a previous article (Compt. rend 222, 1032(1946)) the authors have studied the application of the Tomonage-Schwinger-Dyson theory to the case of the interaction between the pseudoscalar meson field and the nucleonic field. By the Schwinger transformation, the second-order Hamiltonian is obtained in the interaction representation. Using this Hamiltonian, the author studies the Compton effect for the mesons of Kemmer's symmetric theory. The S matrix element for this process is derived, and the effective differential cross section is calculated for an arbitrary reference system. It is noted that pseudovector and pseudoscalar couplings are not equivalent in this process.

3237 Recent Developments in the Theory of the Elementary Particles. H. S. Green. Brit. Sci. News 3, 91-2 (1950) Jan.

The author discusses the divergence difficulties in the theories of elementary particles and the different methods which have been proposed to avoid these difficulties. He is of the opinion that subtraction procedures alone will not

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lead to satisfactory results, and he favors the nonlinear electrodynamics suggested by Born. The nonlinear theory is based on a modification of Maxwell's equations, in which some function of the D'Alembertian of the 4-vector potential is set equal to the current 4 vector. This approach is equivalent to the assumption of a finite extension and structure for the elementary particles, although the theory satisfies the requirements of relativistic invariance. The author has constructed a satisfactory electrodynamics by assuming a special form for the function of the D'Alembertian. This function may be unambiguously determined by the application of the principle of reciprocity. This theory not only eliminates the divergence difficulties but also indicates a Gaussian structure for the electron in its ground state, which is what one would intuitively expect from the theory of measurements.

3238 Reciprocal Particles and the Non-Localisable Field Theory of Yukawa. Bernard Kwal. Compt. rend. 230, 184-5(1950) Jan. 9 (in French). (See also NSA 4-2483.)

Yukawa (Phys. Rev. 76, 302(1949)) has recently proposed a nonlocalizable field theory involving not only the field operators $\Omega$, but position and momentum operators $x_\nu$ and $p_\nu$ as well. This theory is based on a set of equations relating these operators. It may be shown that the matrix elements $(x''_\mu \mid \Omega \mid x'_\mu)$ can be written in terms of $X_\mu = \frac{1}{2}(x''_\mu + x'_\mu)$, $r_\mu = (x''_\mu - x'_\mu)$. This substitution is made in the fundamental equations. The author shows that the solutions describe, in different limiting cases, either ordinary point particles or "reciprocal" particles with zero rest mass and finite extension.

3239 Relativistic Interactions Between Two Nucleons. C. Marty. Nature 165, 361-2(1950) Mar. 4 (Letter to the editor).

In this treatment of the relativistic two-nucleon interaction the author expands the wave functions of the deuteron in terms of the products of the momentum eigenfunctions of the nucleons. From this point the treatment is developed along two alternative lines. First the author uses the method of Van Hove (Phys. Rev. 75, 1519(1949)), obtaining a matrix element for the interaction in which the direct coupling terms disappear. However, it is noted that Van Hove's conclusions as to the type of singularity in the static approximation of the potential are invalid and that the interaction matrix does not vanish in the static approximation. The author then gives the relativistic cross section for a neutron-proton collision in the Born approximation for a symmetrical mixture of vector and pseudoscalar fields and evaluates the cross section, using the constants of interaction of the Møller-Rosenfeld theory. This cross section turns out to be $16.2 \times 10^{-28}$ cm$^2$.

3240 Relativistic Nuclear Force. T. Toyoda. Phys. Rev. 77, 853(1950) Mar. 15 (Letter to the editor).

Recent calculations show that the $1/r^3$ singularity in the tensor nuclear force disappears in the relativistically corrected form of the interaction. In these calculations, however, the retardation of the mesonic potential has been ignored. The calculation presented in this paper starts with an explicit expression for the retarded potential, and the author examines the effect of the previously neglected higher order terms. One of these terms corresponds to the Breit interaction for two electrons. The calculation is carried out for a pseudoscalar field. A similar calculation for a scalar field yields only negligible correction terms arising from the retardation.

3241 A Remark on the Coupling of Gravitation and Electron. Hermann Weyl. Phys. Rev. 77, 699-701(1950) Mar. 1.

In Einstein's theory of gravitation one may consider either the metric potentials $g_{ik}$ or both the metric potentials and the components of the affine connection as independent quantities (metric vs mixed theory) in the coupling of gravitational and electronic fields. This makes a difference for the ensuing equations, but one that can be easily straightened out by a slight change of the Lagrangian. (auth)

3242 S-Matrix in Non-Local Field Theory. Hideki Yukawa. Phys. Rev. 77, 849-50(1950) Mar. 15 (Letter to the editor).

In order to deal with the system consisting of two nonlocal fields, or a local field and a nonlocal field, which interact with each other, one must first find the substitute for the Schrödinger equation for the total system. However, the author believes that the S-matrix can probably be obtained more simply by an extension of the procedure used in local field theory. He proposes such an extension, derives the S-matrix, and shows that it is relativistically invariant and unitary. Questions of convergence are now being investigated.

3243 The S-Matrix for Meson-Nucleon Interactions. P. T. Matthews. Phil. Mag. [7] 41, 185-95(1950) Feb. (See also NSA 4-352.)

The possibility is considered of obtaining a divergence-free S-matrix for the interactions of mesons with nucleons along the lines of mass and charge renormalization, which Dyson has so successfully applied to quantum electrodynamics. It has been shown that this can be done for the vector interaction of neutral vector mesons. The procedure is here extended to the scalar interactions of scalar and pseudoscalar mesons, but proves to be quite inadequate to remove all the divergences in the other cases. (auth)

3244 On Two-Component Wave Equations. F. Gürsey. Phys. Rev. 77, 844-5(1950) Mar. 15 (Letter to the editor.)

In two recent letters, Jehle (Phys. Rev. 75, 1609(1949)) and Kilmister (ibid. 76, 568(1949)) have drawn attention to two-component wave equations. The object of this note is to show that such equations can be regarded as degenerate cases of the general wave equation. It is shown that Jehle's field free equation is equivalent to Conway's form (Proc. Roy. Soc. (London) 162A, 147(1937)) of the Dirac equation when the wave quaternion is self-charge conjugate. The equation proposed by Kilmister can be derived from a different quaternion formulation of the wave equation due to Watson (Proc. Cambridge Phil. Soc. 43, 491(1947)) when the wave function is invariant under a time reflection. Thus Kilmister's equation has solutions depending only on the space coordinates, and it is equivalent to two equations of Jehle's type which differ from each other by the sign of their time coordinates.

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3245 A Radioactive Method for Measuring the Adsorption of Dissolved Substances on Liquid Surfaces. Gunnar Aniansson and Ole Lamm. Nature 165, 357-8(1950) Mar. 4 (Letter to the editor).

The following experimental arrangement has been used to study the adsorption of soluble substances on the surfaces of solutions: A thin-window bell-type Geiger-Mueller tube is placed immediately above a circular cup filled exactly to the brim with a solution of the surface-active compound tagged with a built-in radioactive isotope or with a solution of a radioactive ion. The Geiger-Mueller tube counts the particles from the surface-adsorbed molecules or ions and also those from the interior of the solution. However, the fraction of the particles from the interior that is counted decreases very rapidly with the depth below the surface, so that under favorable conditions nearly all the particles counted originate in the surface-adsorbed layer. The fraction of the particles coming from the interior is determined by making a similar measurement with a solution of the same isotope in a non-surface-active compound. Such measurements were used to test Gibbs' adsorption equation, but the results were inconclusive.

3246 The Utilization of Artificial Isotopes. O. Monecke. Mitt. chem. Forsch.-Inst. Ind. österr. 3, 73-4(1949) (in German).

The author lists the applications of artificial isotopes in the fields of experimental nuclear physics, analytical and physical chemistry, metallurgy, biological and medical research, and medical diagnostics and therapy. The American practice of shipping radioactive materials is briefly described.

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3247 Apparatus for Handling Materials. F. C. Henriques, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,500,492, Mar. 4, 1950.

Samples of radioactive materials are assayed by remote control in apparatus including a rotatable sample table with provision for mounting a number of samples, shielded counting means for assaying a particular sample, and apparatus for inserting and removing samples from the table.

3248 Condensation Product and Process. E. T. McBee and J. S. Newcomer (to U. S. Atomic Energy Commission). U. S. Patent 2,506,428, May 2, 1950.

A new compound, $C_6HCl_{11}$, which is white, crystalline, and melts at about 160°C is obtained by condensing an octachlorohexatriene with trichloroethene in the presence of aluminum chloride.

3249 Cyclic Compounds and Method of Making. F. B. Stilmar, W. S. Struve, and R. N. Lulek (to U. S. Atomic Energy Commission). U. S. Patent 2,503,078, Apr. 4, 1950.

New compounds monohydro-tridecafluoro-ethylcyclopentane, monohydro-monochloro-dodecafluoro-ethylcyclopentane, and monohydro-dichloro-undecafluoro-ethylcyclopentane are formed by fluorination and cyclization of 2, 4-dihydro-3-trichloroethenyl-perchloropentane ($C_7H_2Cl_{12}$) and its dehydrohalogenation products ($C_7HCl_{11}$ and $C_7Cl_{10}$).

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3250 Method of Making Fluorinated Organic Compounds. M. A. Perkins (to U. S. Atomic Energy Commission). U. S. Patent 2,499,833, Mar. 7, 1950.

Undecachloro-octene ($CHCl = CCl\text{-}CH(CHCl\text{-}CCl_3)\text{-}CHCl_2$) and its dehydrochlorination products $C_8H_4Cl_{10}$, $C_8H_3Cl_9$, and $C_8H_2Cl_8$ are reacted first with $SbF_5$ or $AsF_5$ and then with $CoF_3$, $MnF_3$, or $AgF_2$ to obtain such products as $C_8F_{18}$, $C_8ClF_{15}$, and $C_8Cl_2F_{14}$.

3251 Perhalogenated Ethylcyclopentane. F. B. Stilmar, W. S. Struve, and R. N. Lulek (to U. S. Atomic Energy Commission). U. S. Patent 2,503,077, Apr. 4, 1950.

Perhalogenated ethylcyclopentanes of the molecular formula $C_7Cl_xF_{14-x}$, wherein x has a value from 0 to 3, are prepared by fluorination of monohydro-perfluoro-ethylcyclopentanes and monohydro-chloro derivatives thereof.

3252 Preparation of Higher Chlorides of Uranium. H. G. Reiber (to U. S. Atomic Energy Commission). U. S. Patent 2,499,836, Mar. 7, 1950.

Uranium hexachloride is formed by chlorinating uranium oxides with a mixture of chlorine gas and carbon tetrachloride vapor.

3253 Vapor Phase Fluorination Process. A. F. Benning (to U. S. Atomic Energy Commission). U. S. Patent 2,505,877, May 2, 1950.

A vapor-phase process for fluorinating organic compounds is disclosed wherein the vapor of the organic starting material and elemental fluorine are separately introduced into a reaction chamber filled with a permeable body of catalyst comprising copper particles coated with silver, the copper particles having a diminishing mass to area ratio in the direction of gas flow through the chamber.

3254 Dispensing Nozzle. Oran E. Miller (to U. S. Atomic Energy Commission). U. S. Patent 2,492,365, Dec. 27, 1949.

This invention is composed of a dispensing nozzle used to fill containers and a valve which closes automatically when the container becomes filled so that overflowing is avoided. The special feature of the nozzle described here is that it responds only to liquids, but not to vapors, and may therefore be used for readily vaporizable liquids.

3255 High Speed Mercury Diffusion Pump. G. R. Stoltenberg (to U. S. Atomic Energy Commission). U. S. Patent 2,499,839, Mar. 7, 1950.

A small-size multistage high-speed mercury diffusion pump obtains low ultimate pressure at higher fore pressure by diffusion-pump control of ratio of jet diameters and amount of jet overlap.

3256 Pressure Measuring Device. W. R. Perrot and Thomas Davis (to U. S. Atomic Energy Commission). U. S. Patent 2,506,431, May 2, 1950.

Disclosed is a Phillips-type vacuum gauge which is operable on full-wave alternating current, thereby achieving an unusual sensitivity in very high vacuums.

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3257 Valve. H. E. Wirth (to U. S. Atomic Energy Commission). U. S. Patent 2,501,461, Mar. 21, 1950.

A valve for single-direction flow of fluids, comprising a glass system composed of a conduit entering a vertically disposed chamber, which is provided with a wafer resting on a ring which encircles the end of the conduit in the chamber. The ring is positioned flush with or slightly above the end of the conduit and provides an airtight seal with the wall of the chamber so that the wafer resting on the ring plugs the backward passage of gas or fluid from the chamber above the wafer through the conduit.

3258 Well Logging Detector Calibration. Gerhard Herzog (to the Texas Co., New York). U. S. Patent 2,493,346, Jan. 3, 1950.

In that type of well or bore hole logging in which a radiation detector is passed through the hole to measure the natural $\gamma$-ray activity of the formations traversed by the hole, it is known that the plateau of the counter varies somewhat with temperature, which necessitates frequent calibrations of the instruments. The present invention provides two radiation detectors mounted in the probe which is lowered. Mounted in fixed relation to one of the detectors is a small source of radioactive material. The detector closest to this source responds to radiation from it, and any change in the operation indicates a temperature change. The other detector is shielded from the source and responds to $\gamma$ rays from the formations surrounding the hole. Thus temperature variations can be taken into account by simultaneous measurement of the output of both detectors.

3259 Air Proportional Counter. E. W. Molloy (to the U. S. Atomic Energy Commission). U. S. Patent 2,499,830, Mar. 7, 1950.

An alpha-sensitive proportional counter has been designed to operate at atmospheric pressure and with air as the ionizing medium. A coarse-mesh screen outer electrode freely admits alpha particles to the counter.

3260 Cyclotron Oscillator System. Winfield W. Salisbury (to Collins Radio Company, Cedar Rapids, Iowa). U. S. Patent 2,492,324, Dec. 27, 1949.

Oscillator-generator tubes used for frequency-modulated cyclotrons must deliver a large amount of power and are consequently quite bulky, so that it is necessary to locate them at some distance from the dees of the cyclotron. A method is described whereby the output from the tubes can be fed to the cyclotron electrode through a transmission line of continuously varying capacitance, with an over-all phase shift satisfying the requirement for sustained oscillation.

3261 Cyclotron Target. A. F. Reid (to U. S. Atomic Energy Commission). U. S. Patent 2,504,585, Apr. 18, 1950.

An improved target for use in the production of radioisotopes of iodine and/or other elements by bombardment with high-velocity subatomic particles such as deuterons comprises a heat-conductive base such as copper having a relatively thin, adherent layer of thallium tellurite thereon.

3262 Magnetic Flux Measuring Apparatus. E. H. Plesset (to U. S. Atomic Energy Commission). U. S. Patent 2,506,433, May 2, 1950.

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Disclosed is an apparatus for measuring the flux density through a magnetic field distributed over a wide area. The apparatus includes an exploring or search coil which is moved along a predetermined path in which the variation of magnetic flux density is to be measured, the output of the search coil being amplified and the current resulting from the amplified output being integrated, amplified, and applied to an oscilloscope.

3263 Mass Spectrometer Tube Ion Source Assembly. Alfred O. C. Nier (to Regents of the University of Minnesota, Minneapolis, Minn.). U. S. Patent 2,490,278, Dec. 6, 1949.

Conventional mass-spectrometer tubes have been so constructed that the ion source is not readily removable once the tube is completed because it is necessary to degas the tube by the application of heat and pumping before it is put into operation. Details of construction are here given whereby the ion source can be made capable of assembly or disassembly from the tube proper, so that it can easily be serviced.

3264 Method and Apparatus for Detecting Ionizing Particles. Elizabeth R. Graves (to U. S. Atomic Energy Commission). U. S. Patent 2,506,419, May 2, 1950.

A counting device and electrode assembly for detecting fission fragments in the presence of other ionizing particles is disclosed.

3265 Proportional Counter. J. A. Simpson, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,505,919, May 2, 1950.

A proportional counter, sensitive to alpha particles, adapted for probing beakers and other small containers is described. The outer electrode is a tube of small diameter with a permeable window at one end. The anode is in the form of a loop mounted close to the window and is adjustable to allow variation in the operating voltage.

3266 Radiation Measurement. B. B. Rossi and J. S. Allen (to U. S. Atomic Energy Commission). U. S. Patent 2,506,435, May 2, 1950.

High-amplitude voltage pulses from a radiation counter are produced by periodically impressing a potential upon the electrodes greater than the sparking potential of the tube. An ionizing event occurring while this voltage is impressed creates a large voltage surge.

3267 Rectangular Pulse Amplifier. Q. A. Kerns (to the U. S. Atomic Energy Commission). U. S. Patent 2,500,756, Mar. 14, 1950.

A power amplifier capable of amplifying rectangular voltage waves without distortion.

3268 Vacuum Leak Detector Method. R. B. Jacobs (to U. S. Atomic Energy Commission). U. S. Patent 2,504,530, Apr. 18, 1950.

A mass-spectrometer leak-detecting system wherein a flow-proportioning valve is used to proportion the flow of gas from the system being treated to the mass spectrometer so as to maintain the vacuum of the mass spectrometer at the point of maximum efficiency.